DOCUMENT RESUME

ED 397 256 CE 072 082

TITLE	Skill Standards and Certification Project. Final Detailed Report. Year Two.
INSTITUTION	North Lake Coll., Irving, TX.
SPONS AGENCY	Texas Education Agency, Austin.; Texas Higher Education Coordinating Board, Austin.; Texas State Dept. of Commerce, Austin.
PUB DATE	Jun 95
NOTE	235p.; For a related report, see CE 072 081.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC10 Plus Postage.
DESCRIPTORS	Apprenticeships; Certification; Competence; Competency Based Education; Curriculum Development; *Electricians; *Job Analysis; *Job Skills; *Occupational Information; Pilot Projects; Skilled Occupations; Standards; *State Curriculum Guides; Technical Occupations; Two Year Colleges
IDENTIFIERS	Secretarys Comm on Achieving Necessary Skills; *Texas

ABSTRACT

This document reports on the second year of a project conducted to design a seamless training application model for infusing workplace skills into academic and occupational programs at the secondary, postsecondary, and apprenticeship level using the components of SCANS (Secretary's Commission on Achieving Necessary Skills). For this pilot project, the demand occupation of electrical worker (electrician) was selected. Activities during the second year included field testing of the enhanced curriculum, faculty development plan, and assessment strategies developed during the first year. An instructor developed and implemented learning activities based on the SCANS identified skills necessary to improve student success in reading for information, locating information, applied technology, and applied mathematics. Pretests and posttests were administered but did not show much difference, perhaps because of the short amount of time between each administration. Competency profiles for each course were developed, and faculty development activities were conducted, including the development of fact sheet; an electronic newsletter, workshops, videotapes, and a mentoring plan. Products contained in appendixes to the document include the following: course syllabi; a review of electrical construction occupation descriptions paired with SCANS; an electrical technology competency profile; fact sheets; an electronic newsletter; a competency-based education and SCANS workshop plan; ACT Work Keys occupational profile for construction electrician; sample wiring diagram and assignments; electrical construction operations report; and ACT Work Keys test descriptions. (KC)

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FINAL DETAILED REPORT
Year Two

Skill Standards and Certification Project

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Project # 55100007
North Lake College Skill Standards and Certification Project

Final Detailed Report

North Lake College Skill Standards and Certification Project
January 1 - June 30, 1995

Project Bidder:
North Lake College

Project Co-Bidder:
Dallas Electrical Joint Apprenticeship and Training Committee

Submitted To:
The Texas Higher Education Coordinating Board

Funded Through:
The Carl D. Perkins Vocational & Applied Technology Act of 1990

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Angie Runnels
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Carol Marlow

June 30, 1995

Acknowledgments

Sincere appreciation is extended to the following consultants, industry experts, faculty content experts, and North Lake College administrators who contributed to the efforts of the North Lake College Skill Standards and Certification Project.

North Lake College Administration:
College President - James F. Horton, Ph.D.
V.P. of Academic and Student Affairs - Angie S. Runnels, Ph.D.

North Lake College Faculty:
Electrical Technology Program Coordinator - Larry Blevins
Video Technology Program Coordinator - Bill Coppola

Dallas Electrical Joint Apprenticeship and Training Committee:
Director - A.C. McAfee
Consultant - Ronald O'Riley

Consultants:
Curriculum Development - Ike Buddin
Faculty/Staff Development - Jill Gargano

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I. Introduction

This report documents the activities conducted from January 1, 1995 - June 30, 1995 under the Skill Standards and Certification Project funded by the Texas Higher Education Coordinating Board. In keeping with the spirit and intent of the U.S. Department of Labor ***Secretary's Commission on Achieving Necessary Skills, The Smart Jobs Strategy Report to the Governor, The Master Plan for Career and Technical Education and the School-to-Work Transition Plan,*** the overall goal of this Project is to make the concept of a world-class workforce a reality.

The purpose of the North Lake College Skill Standards and Certification Project has been to design a seamless training application model for infusing workplace skills into academic and occupational programs at the secondary, post-secondary and apprenticeship levels.

For the purpose of the pilot of this Project, the "demand" occupation of Electrical Worker was selected by North Lake College. Electricians are essential to economic development in Texas especially in areas of increased construction and renovation. According to the North Central Texas Interlink, Inc. "1993-2000 Demand Occupations" publication, electricians are included in their "Top 40" occupation list for those occupations that will

be in high demand and will require formal education beyond high school.

North Lake College partnered with the Dallas Electrical Joint Apprenticeship and Training Committee (DJATC) to accomplish project objectives, activities, and products. The National Electrical Joint Apprenticeship and Training Committee, the International Brotherhood of Electrical Workers and the National Electrical Contractors Association are leading the development of National Skill Standards for the electrical industry. The IBEW is developing the occupational tasks, the NECA (with support from a Federal Grant) is developing the skill standards, and the NJATC will review and dove-tail the two projects.

For the purpose of this Project seven workplace skill areas were targeted for curriculum applications: Reading for Information, Writing, Applied Mathematics, Listening, Teamwork, Locating Information, and Applied Technology.

Project deliverables for the first year of the Project (January, 1994 - December, 1994) included:

1. An ***Occupational Profile Handbook***
2. A workplace skills ***Curriculum Review and Enhancements*** proposal
3. A ***Faculty Development Plan***
4. ***Licensure, Testing, and Certification*** strategies

The American College Testing Program (ACT) was the occupational profiling contractor for the Project. Through their *Work Keys* process which utilizes local subject matter experts they provided an electrician job profile which involved the following three steps:

1. Developing a list of the most critical tasks to the occupation
2. Identifying on-the-job behaviors associated with each skill as it is used in the occupation
3. Determining the *Work Keys* skill levels of the occupation

Texas A & M's Public Policy Research Institute performed Project evaluation activities. They reported Project results, conducted process and outcome evaluations, and provided public policy recommendations to the State.

After a comprehensive review of the Project models and products generated in the first year of the Project, a decision was made by the State of Texas to continue funding for an additional six months. This continuation funding provided the opportunity to field test the enhanced curriculum, faculty development plan, and assessment strategies proposed during the first year. DJATC, the industry partner for this Project, agreed to continue in their role and to provide the necessary linkage to the National Skill Standards and Job Task Analysis information as they become available for the electrical industry.

II. Description of Work

Descriptions of work activities have been divided into four areas: administrative activities, curriculum enhancements, testing/assessment enhancements, and faculty development activities.

Administrative Activities

Various activities were conducted which were administrative in nature and supported Project objectives.

- Conducted Advisory Committee Meeting

On March 22, 1995, the first advisory committee meeting for the Project was held at the Dallas Electrical Joint Apprenticeship and Training Committee facility in Dallas. Carol Marlow led the meeting and provided a summary of first-quarter activities. Members of the Committee offered suggestions and comments on activities to assist the Project in accomplishing second-year objectives. The Committee consisted of the following members: Larry Blevins, NLC, Electrical Technology, program coordinator; AC McAfee, director, Dallas Electrical Joint Apprenticeship and Training Committee; Ronald O'Riley, consultant; Jill Gargano, faculty/staff development consultant; Ike Buddin, curriculum consultant; and Carol Marlow, NLC, project director.

- Attended School to Work Conference at TSTC-Marshall

This activity consisted of attending a conference on January 27, 1995, in Marshall sponsored by Texas State Technical College on school-to-work initiatives. Featured speakers included Mark Tucker, president, National Center on Education and the Economy, on "School-to-Work: The National Perspective" and Deron Bissett, planner, Texas Department of Commerce on "School-to-Work: The Education Perspective, Certificate of Initial Mastery/Career Passports." The four Skill Standards and Certification Projects attended and met in the afternoon in a planning session with Larry Keys in attendance.

- Attended League of Innovation "Workforce 2000" Conference

This activity consisted of attending the national conference on workforce development sponsored by the League of Innovation which provided continuing education and networking opportunities in the areas of tech prep, skills standards and certification, contract training, and continuous quality improvement. Information from the conference was used in Project publications and consultations on workforce development.

- Developed and Administered Budget

The Project budget was negotiated with Larry Keys and submitted to the Coordinating Board for approval. The budget and internal accounts were processed through the DCCCD District Resource Development Office and North Lake College Business Office.

- Met with Dallas Electrical Joint Apprenticeship and Training Committee Director

The partnership with the Electrical Apprenticeship training program continued into the second Project year. As part of their participation with the Project, the DJATC assisted with the application of interim national job analysis information available from the U.S. Electrical Construction Industry Skill Standards and Certification Project on "Electrical Construction Occupations."

- Hired Consultants

The Project Director hired three consultants to assist in accomplishing Project activities. Jill Gargano, consultant during the first year of the Project, continued with the Project and developed Fact Sheets on SCANS and the North Lake College Skill Standards and Certification Project model. In addition, she presented at the University of North Texas SCANS Research workshops and developed the CBE workshop plan. Ike Buddin, curriculum consultant, developed enhanced syllabi and the competency profile. Bill Coppola, NLC faculty, developed the electronic format for the newsletter and conducted a faculty orientation. In addition, he researched and identified video tapes for faculty development to promote SCANS.

- Met with Project Consultants and Staff

Regular meetings with Larry Blevins, NLC Electrical Technology program coordinator, were held to discuss accomplishment of Project objectives relative to assessment and

curriculum enhancement implementation.

- Wrote Project Reports

First-quarter, second-quarter, an executive summary, and a final detailed report were drafted and submitted as requested by the funding source.

- Hosted Evaluator Site-Visit

Texas A&M Public Policy Institute conducted a site-visit evaluation with North Lake College on May 18, 1995. They interviewed Carol Marlow, Jill Gargano, Larry Blevins, Bill Coppola, Ike Buddin, and AC McAfee regarding Project status and outcomes.

Curriculum Enhancements

An analysis of the curriculum is an essential prerequisite to designing and implementing curriculum revisions. Knowledge of the curriculum through a review process establishes the need and provides the foundation for enhancements. During the first year of the Project, a thorough review of the Electrical Technology curriculum was conducted and criteria were developed for enhancement selection. Prototype enhancements were developed for SCANS infusion into the curriculum.

In the second year, it was determined curriculum enhancements would be applied and evaluated in all Spring semester Electrical Technology courses taught by Mr. Blevins. They included: ELE 105: "Introduction to Electrical Technology;" ELE 115: "Low Voltage Circuits;" and ELE 116: "General Electrical Wiring." Project activities included revising course syllabi and implementing curriculum enhancements.

- Revised Electrical Technology Course Syllabi

Ike Buddin worked with Larry Blevins to develop enhanced syllabi for the three selected courses. The purpose of this activity was to specify and incorporate curriculum improvements in the Electrical Technology program. Included in this activity was an assessment of SCANS competencies appropriate for each course and an effort to infuse these competencies into the curriculum.

This activity began with a review of existing course materials (syllabi, texts, study guides, etc.) and consideration of SCANS competencies taught and enhancements developed during first-year activity. Content goal statements which specified tasks each student would perform toward course completion were developed.

Work activities included periodic reviews of the materials developed, discussions of program characteristics influencing curriculum development, discussions related to testing and evaluation methods used, and a review of the ACT *Work Keys* Occupational Profile for Construction Electricians. The Profile was developed during first-year activity and appears in Appendix A.

SCANS assessments were based on a list of SCANS competencies which divides each of the eight basic competencies and foundations into "subcompetencies." By using this approach, very specific competencies were built into the curriculum.

A substantial portion of the revised curriculum was developed using CourseBuilder 3.0 software published by Instructional Performance Systems, Inc. (IPSI). This software uses a pedagogical process which includes creation of content goals and performance objectives, sorting content goals according to domain, level of learning, frequency, difficulty, purpose, and sequence, and final development of course syllabi. The content goals specify the behavior to be performed by the student. The performance objectives

add conditions and standards for each behavior.

The products produced by the above activities appear in Product Section A and include:

- Three comprehensive course syllabi for the selected courses, each having 31 to 42 content goals and corresponding performance objectives
- SCANS assessments which specify the SCANS competencies developed by each content goal
- A crosswalk form which specifies the ACT competencies for each content goal
- Documentation which specifies the decisions made about each content goal (domain, level, frequency, difficulty, and purpose)
- A statistical summary which outlines general characteristics of content goals for each course
- In addition, a comprehensive course syllabi was developed for a fourth course, ELE 206, Commercial Planning.

To facilitate the process, the performance objectives included statements which identified the evaluation instruments to be used. Additionally, each syllabus was formatted to identify the point value for each content goal and to give the student a column to identify points earned as they progress through the course.

- Implemented Curriculum Enhancements

Larry Blevins developed and implemented learning activities based on the SCANS identified skills necessary to improve student success within the electrical technology field. These learning activities supported the mastery of the skills of reading for information, locating information, applied technology and applied math.

In ELE 105, Introduction to Electrical Technology, several projects/learning activities were introduced to improve student skills to locate information. Enhancement strategies included:

- Assigning activities requiring the use of a computer-based National Electrical Code manual.
- Assigning activities requiring the use of the Illustrated Dictionary for Electrical Workers
- Completing crossword puzzle activities using industry terms
- Assigning activities requiring the use of trade catalogs

The introduction of the National Electrical Code software provided students with the opportunity to locate information electronically. During this activity, students were required to find answers to specific problems by performing word searches. Students entering the course with a limited technical vocabulary found this approach very helpful. Another resource utilized by the students to promote the mastery of locating information

was the Illustrated Dictionary for Electrical Workers. Students were given reading assignments requiring them to locate the specific answer to a problem. They used the Dictionary to ensure they understood the code sections found. In addition, crossword puzzles using electrical trade terminology were used and the Dictionary provided an additional resource to improve the student's technical vocabulary.

A skill reported as lacking by the Electrical Technology Advisory Committee was the ability to identify materials. In response to this need, several student projects were developed using electrical trainers (simulated electrical work stations) and industry trade catalogs. These assignments provided an effective means of testing a student's understanding of the different materials required in the electrical industry. Since trainers provide hands-on learning opportunities, students were better able to associate materials with the trade catalog descriptions.

In ELE 115, Low Voltage Circuits, the following activities were introduced to improve student skills to read for information. Enhancement strategies included:

- Enhancing lab projects
- Installing a burglar alarm using manufacturer's instructions

In this course, the lab project workbooks were revised to include additional testing using meters. This activity reinforced the mastery of applied technology as well as reading for

information. Various types of electrical meters were used following manufacturer's instructions. Students were required to read and interpret the instructions and identify proper testing techniques and procedures. Students initially had difficulty interpreting the manufacturer's instructions for a dwelling-type alarm control unit and various associated components. As they became more familiar with the manufacturer's information sheets, the students were able to interface the different components and performed exceptionally well in the hands-on wiring process.

In ELE 116, General Electrical Wiring, the following activities were introduced to improve student skills to apply technology and math. Enhancement strategies included:

- Using computer-based instruction
- Assigning activities requiring the use of a computer-based estimating program
- Assigning activities requiring the use of a computer database material inventory.

In this course a computer program called "Get Wired" was introduced to promote the mastery of applied technology and applied math. The software included an on-line textbook including video, a catalog of tools and materials, and methods for calculating box sizing, service sizing, load requirements, and voltage drops. It also included a circuit simulator for drawing wiring diagrams and circuit operations. The "Get Wired" software allowed students to electronically "test" lab projects as a safety feature prior to the actual

hands-on testing in a lab environment. This exercise provided a safer test situation by simulating a "real" wiring activity. Additionally, it provided students with an opportunity to visualize various wiring applications "in the mind's eye." An illustration of a computer-generated wiring diagram and sample assignments appear in Appendix B.

Another enhancement strategy included utilizing a computer-based electrical estimating program to promote applied math and determine the time and material required for the completion of each of the hands-on wiring projects. This provided each student with a standard by which they could measure their progress. All material was compared to a database software program to determine any wiring variations that may have occurred. Several wiring options were available and each student was permitted to utilize the method they felt would be most appropriate. Some wiring options were not as effective as others, but each experience was shared allowing students the opportunity to analyze options. All wiring must comply with accepted National Electrical Code standards, but an electrician on the job must determine the method of wiring that is most appropriate.

- Applied National Job Analysis and Skill Standards Information

The U. S. Electrical Construction Industry Skill Standards and Certification Project has produced the document, "Electrical Construction Occupations" which consists of interim job descriptions and KSA lists for the occupations of Electrical Construction Worker, Electrical Line Construction Worker, and Electrical Residential Construction Worker.

A.C. McAfee, director, Dallas Electrical Joint Apprenticeship and Training Committee, has reviewed the information in this report in terms of the relationship between duties identified for the three job descriptions and the required workplace skills needed to perform them. The results of this review are depicted on three matrices and appear in Product Section B. Note: While the report provided information that is "interim" and may be modified, it was considered useful to this Project. The U.S. Electrical Construction Industry report appears in Appendix C.

Skill standards for the three occupations will be developed in the upcoming months and would provide valuable input to the North Lake College Electrical Technology program and to the Dallas Electrical Joint Apprenticeship and Training program for curriculum validation purposes.

Testing /Assessment Enhancements

Assessment of student achievement is essential to determine whether students have mastered course content and attained performance objectives. The purpose of testing in this Project was to determine if students had mastered workplace competencies required for success in the electrical construction industry. These assessments were given in addition to the testing of technical competencies normally conducted during the semester.

The assessment activities developed specifically for this Project included: administration of the ACT *Work Keys* pre- and post tests, the development of an Electrical Technology competency profile, and the implementation of computer-based testing.

- Administered ACT *Work Keys* Assessments

Students enrolled in the three Electrical Technology program courses targeted in the Project were given pre- and post tests during the Spring semester. These tests were ACT *Work Keys* criterion-referenced assessments designed to measure locating information, applied mathematics, applied technology, and reading for information skills. A decision was made to test a sample group of students in each of the three courses targeted for curriculum enhancements. The following pattern of assessment was employed for pre- and post testing:

- Locating Information was tested in ELE 105, "Introduction to Electrical Technology"

- Reading for Information was tested in ELE 115, "Low Voltage Circuits"
- Applied Technology and Applied Math were tested in ELE 116, "General Electrical Wiring."

The pre-tests were administered in February and the post tests were administered at semester's end in early May. Test descriptions for the four assessments are provided in Appendix D. All assessments were multiple choice with questions arranged from simple to complex. Test time ranged from 35-45 minutes. Completion of general information required an additional 20 minutes. Tests were scored by the ACT organization who provided aggregate and individual results.

The tables on the next pages illustrate test results.

Course Title: ELE 105, Introduction to Electrical Technology

LOCATING INFORMATION SKILL ASSESSMENT			
Test Subject	**Pre-Test Score**	**Post Test Score**	**Difference**
Student A	4	4	0
Student B	4	5	+1
Student C	4	5	+1
Student D	6	6	0
Student E	4	3	-1
Student F	4	5	+1
Student G	5	4	-1
Student H	3	3	0
Student I	3	below 3	-1

Course Title: ELE 115, Low Voltage Circuits

READING FOR INFORMATION SKILL ASSESSMENT			
Name	**Pre-Test**	**Post Test**	**Difference**
Student A	5	7	+2
Student B	4	6	+2
Student C	6	6	0
Student D	5	5	0
Student E	6	5	-1
Student F	5	5	0

Course Title: ELE 116, General Electrical Wiring

APPLIED TECHNOLOGY SKILL ASSESSMENT			
Name	**Pre-Test**	**Post Test**	**Difference**
Student A	6	6	0
Student B	3	3	0
Student C	below 3	below 3	0
Student D	6	6	0
Student E	below 3	3	+1
Student F	5	6	+1
Student G	below 3	4	+2

Course Title: ELE 116, General Electrical Wiring

APPLIED MATH SKILL ASSESSMENT			
Name	**Pre-Test**	**Post Test**	**Difference**
Student A	6	6	0
Student B	3	below 3	-1
Student C	6	7	+1
Student D	4	5	+1
Student E	7	6	-1
Student F	5	5	0

Note: Test results are presented only for students who took both the pre- and post tests.

After conducting the assessments and reviewing test results, the following observations can be made:

- While some students demonstrated measurable gains in skill attainment, many students's skill levels remained constant. Other student's skill levels were assessed at a lower level on the post test. These results are currently under study and could be attributed to the short amount of time between pre- and post test administration indicating additional time is needed for skill acquisition and the influence of other variables.

- ACT provides an objective, external assessment and scoring service.

- The ACT *Work Keys* assessments are not an applied testing instrument and therefore do not measure specifically for the electrical construction occupation

- More evaluation of the assessment methodology is warranted for further activity.

■ Developed an Electrical Technology Competency Profile

One of the basic concerns in the Electrical Technology program relates to student enrollment patterns. While some students are consistent in their pursuit of a degree or certificate, many others enroll sporadically, complicating the learning process and the

teaching methods used. The purpose of this activity, therefore, was to create a competency profile which would assimilate Electrical Technology course competencies into a long-term record for the file. This record file would then be maintained for each student as a means of reviewing past educational accomplishments and help identify remedial training requirements. The courses involved were:

- ELE 105, Introduction to Electrical Technology
- ELE 115, Low Voltage Circuits
- ELE 116, General Electrical Wiring
- ELE 206, Commercial Planning

Actions for this activity included a review of competency profiles developed by different institutions. Discussions between Carol Marlow, Larry Blevins, and Ike Buddin helped determine the characteristics the final profile should have. A course-by-course profile was selected due to the pattern of student enrollment and individual course selection.

This activity developed as a logical extension of the work done in the curriculum enhancement activity. Competencies developed in that activity were assimilated into a composite profile to be maintained for each student entering into the program. A determination was made to include a summary of SCANS and ACT competencies in the profile as industry relevant skill requirements.

Special effort was made to produce a profile that would be practical for instructors to use. The profiles were designed to be as succinct as possible and have a format that would lend itself to management using a computer database. They were designed with three primary components. The first component contains student baseline data including, name, address, educational objective, enrollment history, list of courses, semester completed, grade received, and instructor. The second component contains ACT/SCANS summary information including a list of the ACT and SCANS competencies addressed within each course. The third component contains student performance summary information including a list of content goals with a 1-5 rating scale applied to each goal. The Electrical Technology Competency Profile appears in Product Section C.

- Incorporated Computer-Based Testing

Computer-based testing serves as both an enhancement to the testing process and the curriculum. It provides the instructor and student with immediate feedback on test results. In addition, it provides the instructor with important test analysis information, as well as a more efficient means of scoring, administering, and improving the test instrument. Also, computer-based training provides the opportunity to enhance the testing experience with graphics and motion. During the second year of this Project, computer-based tests were developed for safety testing and the final exams in the Spring semester courses. Both students and the instructor preferred this testing method.

Faculty Development

During the first year of this Project it was recommended that a variety of faculty development strategies be used to teach faculty how to improve their instruction and incorporate workplace skills into their programs to ensure that curricula is industry-driven. The following strategies were employed during the continuation of this Project:

- Developed Fact Sheets

Multi-media communications in the form of Fact Sheets was one recommendation. The Fact Sheets are brief papers on subject areas that faculty find interesting and germane to their development needs. They were designed as a simple and cost effective means of disseminating information that is valuable in professional development. Topic areas are limitless and should be determined by need.

The development of the two Fact Sheets began with an informal assessment of faculty in the Electrical Technology program concerning the need to infuse workplace skills into existing curricula. It was determined by the Program Coordinator and the Project Director that "awareness" was the most logical first step. It was decided that the content of the first Fact Sheet would be a summary of the work conducted by the Secretary's Commission on Achieving Necessary Skills (SCANS), a listing of the SCANS Three-Part Foundation and Five Competencies, and a look at how these skills were validated locally

by a survey of Dallas-Fort Worth area companies.

The content of the second Fact Sheet produced would contain an internal look at strategies currently underway at North Lake College to identify and integrate industry-validated technical and workplace skills into existing curricula.

Research was conducted and the copy for the Fact Sheets was drafted. It was recommended WordPerfect 6.0 software be used to produce the Fact Sheets for internal convenience and cost containment.

The Project Director reviewed the Fact Sheet drafts and recommended a small sample of adjunct-faculty conduct a reader evaluation of them. Faculty reported the Fact Sheets were a useful means of obtaining information on these topics. In addition to the reader evaluation form, faculty participating in this sample were given a written pre- and post test concerning the SCANS identified workplace skills. All four participants scored substantially higher on the post test after reading the Fact Sheets.

After minor modifications to the first draft of the Fact Sheets, it was determined they were an effective tool in workplace skill awareness and a decision was made to produce and disseminate copies to all North Lake College faculty. The Fact Sheets appear in Product Section D.

- Developed an Electronic Newsletter

During the first year of the Project, it was recommended that the information generated from the SCANS research be disseminated to adjunct faculty of the Electrical Technology program through the electronic mail system. The Dallas County Community College District is equipped with a WordPerfect Office E-Mail system. All seven campuses, the Bill J. Priest Center, District Service Center, and The District Central Office are electronically connected. In addition any Internet user can contact District personnel through an individual Internet address. District personnel with a home computer and a modem can be supplied with software to access the district E-Mail system to check messages and send messages from home.

A two-page faculty development newsletter was produced and formatted for the E-Mail environment. Since the computer literacy of the faculty on campus is diverse, a main objective of the project was to keep the technology simple. To properly print a document sent over E-Mail, it must first be saved to WordPerfect on either a floppy disk, or the hard drive. Adjunct faculty might not be at a computer where they have access to a drive to save the information; therefore, the determination was made to reformat the document to be able to print a hard copy from the E-Mail screen that would look exactly like the WordPerfect format.

Once the newsletter was formatted, it was sent on E-Mail to the Faculty Resource Center

on campus. This location has computers set up to receive and print E-mail. Three faculty members volunteered to participate in an evaluation and demonstration of the electronic newsletter. Before the demonstration, a brief explanation of the E-Mail system and a lesson on its basic features was given. The faculty members were then asked to retrieve the newsletter, read it, print it, and respond to an evaluation questionnaire describing their experience using this format. In addition, they were asked to comment on the usefulness of the content in the newsletter.

Responses were very favorable in both the areas of content and delivery. Faculty cited the benefits of the content as providing useful suggestions for the application of SCANS in the curriculum. In addition, they felt the newsletter promoted communications and liked the efficiency and interaction capabilities of electronic mail. A sample E-Mail Newsletter appears in Product Section E.

- Developed a Competency-Based Education and SCANS Workshop

As stated in the Faculty Development document completed during the first year of this project: "Competency based education is a model of education that lends itself to the inclusion of academic and technical skills in the same curricula and incorporates the concepts of teaching workplace skills along with the technical content of a given occupation. The premise is vocational training that is designed with industry needs in mind to develop student skills to perform at the entry level of the occupation. The

utilization of job analysis information as the beginning point of instructional design synchronizes with the ACT *Work Keys* occupational profile as the beginning point of workplace skills infusion into the technical curricula--the focus of this project." Therefore, it was a recommendation of the project to develop a CBE and SCANS Workshop Plan as a means to instruct faculty on how to develop and apply competency-based and workplace skills infused curricula.

Workshop objectives enable participants to:

- List technical and workplace competencies associated with entry level skills of the occupation
- Complete a SCANS analysis
- Develop quality syllabi for courses
- Write performance objectives
- Develop learning activities
- Apply student assessments that are criterion-referenced.
- Use student competency profiles.

It was recommended a mix of learning activities such as case studies, instructional design critiques, video tape viewing, lecture/discussion, small group exercise, readings, task analysis exercises, and expertise sharing sessions be included in the workshop.

Project staff consulted with Jim Steward, post secondary agreement coordinator, Autry Technology Center, Enid, Oklahoma. He presented CBE information developed by the Mid-America Vocational Curriculum Consortium (MAVCC) at "The 15th Annual Mid-

America Competency-Based Education and Training Conference: Achieving Standards through High Quality CBET School to Work Programs." He recommended the Competency-Based Education Professional Development Series developed by MAVCC. The eight unit series was ordered, reviewed, and determined to be a very useful resource for the development of the North Lake College Competency-Based Education and SCANS Workshop.

The resulting workshop has been designed for North Lake College faculty who support the concept of competency-based education and workplace skills integration. Two workshop agendas have been developed. The first is presented in a one-day session. The second is divided into two evening sessions to accommodate adjunct faculty with full-time job commitments outside of their teaching responsibilities. A copy of the Workshop agendas and outline appears in Product Section F.

Workshop instruction covers a review of terminology, methods of collecting job information, and job task detailing. The video: "Competency Based Education: Meeting the Educational Challenges of Today...and Tomorrow!" will be presented.

SCANS analysis and integration will be covered. Other workshop instruction covers how to develop quality syllabi, how to write performance objectives, and how to develop learning activities.

Criterion referenced evaluation instruments used in CBE will be addressed. The use of a competency profile will be presented and how it applies to a particular technical program.

- Developed a Mentoring Plan

The notion of mentoring and faculty development are inextricably tied to one another; and mentoring is a vehicle for faculty development that has been conducted informally in institutions of higher education for a long time. The idea that a more experienced, "veteran" faculty member would be a resource and coach for a less experienced faculty member is consistent with many of the notions where the work environment provides a field setting for learning and applying new concepts. The ability to infuse SCANS into the curriculum and integrate skill standards, both mandates of this grant, requires a different approach to curriculum development, instruction, and evaluation than has been done traditionally. The design for this approach is based upon competency-based education; therefore, faculty must have an understanding of CBE in order to infuse SCANS into their curriculum.

The Mentoring Plan has these elements that would enable faculty to infuse SCANS and integrate Skill Standards:

- Innovative faculty would be invited to participate in North Lake College offerings of workshops sessions on competency-based education and SCANS integration.

- Faculty attending the CBE and SCANS sessions would be asked to serve as mentors to full and part-time faculty in their Division.
- Resource materials would be provided to each faculty that include a variety of information that could be used to counsel faculty members on CBE and SCANS infusion.
- Professional service contracts or other means of compensation and incentives could be provided to faculty mentors to encourage them to devote additional time in this role.
- Faculty mentors would be asked to compile evaluation information and report on their activities at the conclusion of the project and make recommendations.

A support activity to provide the resource materials faculty mentors will need to perform their role would be the provision of a library of materials within the Project office. These holdings would include print materials, video tapes, publications and instructional packets that can be referred to when mentoring. In addition, faculty mentors would have access via The Internet to a variety of bulletin boards and resources to query for additional information.

■ Evaluated Video Tapes for Faculty Development

Another faculty development strategy introduced this Spring was the viewing of video tapes to teach workplace skills infusion. The reason this format was selected was because

it allowed faculty the flexibility of acquiring information when it was convenient to their schedules. The tapes could be viewed on campus or at home. The content of the video tapes included such topics as critical thinking, listening skills, speaking skills, improving technical training skills, defining training objectives, learning domains, and evaluation. Faculty were asked to view these tapes and provide comments on their value. All faculty who participated in this activity felt the tapes were a convenient and useful means of obtaining information.

- Disseminated the North Lake College Skill Standards and Certification Model Statewide

As part of Project activities, North Lake College agreed to participate with other facilitators at two of the "Personnel Development Based On SCANS Research" workshops sponsored by the University of North Texas. Responsibilities included facilitating four activities and presenting the North Lake College Skill Standards and Certification Project model. Copies of the Executive summary from the first year Project were distributed.

The purpose of the Workshop was to provide participants with information on how to identify and implement SCANS competencies and foundations. Objectives of the Workshop were to provide training to:

- Identify workplace competencies based on SCANS research

- Identify trends and issues of competency-based education
- Identify discrepancies of SCANS skills in the curriculum
- Identify procedures and processes used by the Skill Standards and Certification Projects to enhance current curricula
- Develop tools to improve education by implementing, integrating, and applying SCANS into curricula.

North Lake College Project consultant, Jill Gargano, presented at the March 1 workshop in Dallas and the April 7 workshop in Midland. Responsibilities included assisting with registration and workshop materials, facilitating workshop activities, and presenting the results of the first year of the North Lake College Skill Standards and Certification Project. An outline of the North Lake College project presentation appears below:

I. Introduction
   A. Project (Overview)
   B. Occupation (Electrical Worker, construction)
   C. Staff and Partners (NLC, DJATC)

II. Project Areas/Deliverables
   A. Occupational Profiling
   B. Curriculum Enhancements
   C. Professional Development
   D. Testing/Certification
   E. Executive Summary

III. Occupational Profiling
   A. Documented Industry Demand for Workplace Skills
   B. Established Linkage with National Skill Standards (NJATC, IBEW, NECA)
   C. Developed Occupational Profile (ACT *Work Keys*)
   D. Compared SCANS Competencies and Foundations
   E. Evaluated *Work Keys* Process
   F. Applied Profile to Electrician Occupation

IV. Curriculum Analysis
   A. Interview Program Coordinator

B. Conducted Course Observations
C. Studied Course Syllabi and Objectives
D. Reviewed Instructional Materials
E. Reviewed Instructional Methods
F. Gathered and Reviewed Research Materials
G. Employed NLC Faculty Content Experts
H. Convened Curriculum Analysis & Enhancement Team
I. Analyzed and Compared Current Curriculum

V. Curriculum Enhancement
A. Selected Enhancement Criteria
B. Selected Enhancement Strategies
C. Identified Enhancement Prototype
D. Recommended Improvements for Course Documentation and Objectives

VI. Professional Development
A. Conducted Literature Review
B. Conducted Interviews
C. Developed Faculty Learning Objectives
D. Selected Learning Activities/Modes
E. Determined Institutional Support Factors
F. Determined Evaluation Methods

V. Testing/Certification
A. Researched Assessment Strategies
B. Analyzed Current Assessments
C. Recommended Assessment Strategies

VI. Conclusion
A. Deliverables
B. First Quarter Year Two
C. Questions

Workshop participants included Directors of Curriculum, Faculty, Instructors, Directors of Continuing Education, Coordinators of Career Education, Deans, Vocational and Academic Supervisors, PIC Representatives, Program Directors, and Quality Workforce Representatives.

- Consulted with North Lake Faculty on SCANS

The Project Director has had opportunities this past quarter to consult with North Lake College faculty individually and in small groups regarding curriculum development and infusion of SCANS into the existing curriculum. Opportunities have included taking an active role in: a Texas Higher Education Coordinating Board review of the North Lake College Electrical Technology program; academic staff learning community design meetings; a technical occupational task force on program evaluation, and a DCCCD school-to-work grant application committee.

III. Products

Product A:	Course Syllabi
Product B:	Review of interim Electrical Construction Occupation Descriptions paired with SCANS
Product C:	Electrical Technology Competency Profile
Product D:	Fact Sheets
Product E:	E-Mail Newsletter
Product F:	Competency-Based Education and SCANS Workshop Plan

Product A:

Course Syllabi

North Lake College

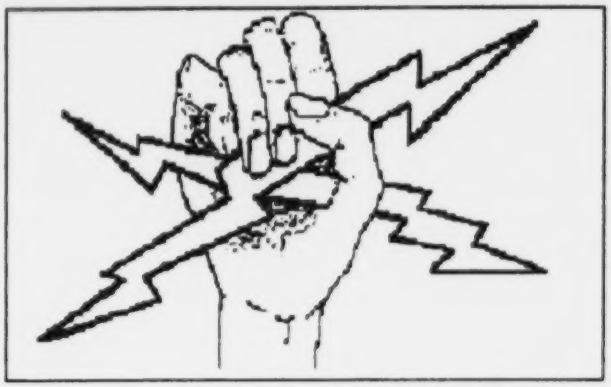
Technology Division

5001 N. MacArthur Blvd.
Irving, TX 75038-3899

Syllabus for

ELE 105 (2 Hrs)
Introduction to Electrical Technology

Fall 1995



Course Description: *No prerequisites. This course focuses on the nature of the electrical technology industry and employment opportunities. Safety, materials, and the proper use of tools and common test devices are covered. Laboratory fee.* (2 Lec., 1 Lab.)

Instructor Information	Class Schedule
Instructor: Larry Blevins **Office:** Room T-125 **Phone:** 659-5331 **Office Hours: MWF:** **T-Th:**	**Class Start Date:** **Location:** **Time:**

Texts and References:

1. House Wiring Simplified, Floyd M. Mix, 1991.
2. National Electrical Code Tabs. Construction Book Company.
3. National Electric Code. National Fire Protection Association.
4. Illustrated Dictionary for Electrical Workers. John Traister.

Course Goals *The following list of course goals will be addressed in the course. These goals are directly related to the performance objectives in Addendum A. (* designates a CRUCIAL goal)*	Point Value	Points Earned
*1. formulate personal electrical-field career strategy	20	
2. outline North Lake College campus support functions	10	
3. define basic electrical terms	10	
*4. outline safe electrical working principles	20	
5. identify electrical conduit and raceway types	10	

6. specify common outlet receptacle uses	10	
7. differentiate common electrical switch types	10	
8. differentiate electrical conductors	10	
9. outline basic wiring system installation procedures	10	
10. explain electrical system modernizing techniques	20	
11. analyze electrical trade catalogs	10	
*12. interpret National Electrical Code requirements	20	
13. interpret electrical symbols	10	
14. identify common electrical housing box requirements	10	
15. determine common household electrical service requirements	10	
*16. solve electrical mathematics problems	20	
17. calculate electrical project material and labor costs	20	
18. identify various circuit and switch wiring principles	10	
19. select electrical tools and equipment	10	
*20. outline electrical test equipment operational functions	20	
21. construct test boards	10	
*22. assemble common low-voltage electrical components	10	
*23. complete computer-based (NEC) research assignments	10	
*24. develop computer-based branch circuit wiring designs	20	
25. demonstrate effective reading and writing skills	20	
26. exhibit effective listening skills	10	
27. demonstrate cooperative interpersonal working characteristics	20	
28. perform electrical service projects	20	
29. perform branch service projects	20	
30. perform feeder circuit projects	20	
31. perform troubleshooting techniques	20	
*32. complete course Test I	100	
*33. complete course Test II	100	
34. update personal electrical-field career strategy	0-20	

Student Contributions:

You should spend at least 4 hours per week preparing for class. Attendance is critical in this class.

Course Evaluation:

Your performance objectives and exams will be translated to points and the points to grades. There are 650 points possible and grades will be earned as follows: A=650 to 585, B=584 to 520, C=519 to 455, D=454 to 390.

Instructional Method

This course will be taught by a combination of self-study and lecture/discussion. Laboratory courses will include demonstration and hands-on tasks performed by students.

Attendance Policy

You are expected to attend class regularly and to consult with me whenever an absence is necessary. If you are unable to complete this course, you must withdraw from it by _____. Withdrawing from a course is a formal procedure which you must initiate; I cannot do it for you. You may do this in Admissions or Counseling. If you stop attending and do not withdraw, you will receive a performance grade, usually an "F".

The following rules will apply in any course where students participate in hands-on work assignments or tasks involving the use of tools and/or equipment in the laboratory:

- You will follow recognized safety practices.
- Posted safety rules will be followed.
- You will pass a safety test.
- Failure to comply with safety rules and repeatedly endangering yourself and/or other students will result in your removal from the course.
- Safety glasses are required to be worn when hazards to the eyes may exist. Glasses may be purchased at the North Lake College Bookstore.

Addendum A
Performance Objectives

1. You will be allowed references. You will formulate a personal electrical-field career strategy. Performance will be satisfactory if a strategy is formulated and the formulation receives a minimum of 7 on a 1-10 scale from the instructor.

2. You will be allowed references. You will outline North Lake College campus support functions. Performance will be satisfactory if three major support functions are outlined and the module exercise for this assignment is completed by the 3rd class session.

3. You will not be allowed references. You will define basic electrical terms. Performance will be satisfactory if terms are defined and the definitions are consistent with the text and classroom instruction. Evaluation instrument(s): Daily quiz; Test I.

4. You will not be allowed references. You will outline safe electrical working principles. Performance will be satisfactory if principles are outlined and the outlining is consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

5. You will be allowed references. You will identify electrical conduit and raceway types. Performance will be satisfactory if types are identified and the identification are consistent with the text. Evaluation instrument(s): Daily quizzes, Test I.

6. You will not be allowed references. You will specify common conduit and receptacle applications. Performance will be satisfactory if applications are specified and the specifications are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

7. You will not be allowed references. You will identify common electrical switches and other materials. Performance will be satisfactory if switches and other materials are identified and the identifications receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz; Test I.

8. You will not be allowed references. You will differentiate electrical conductors. Performance will be satisfactory if conductors are differentiated and the differentiations are consistent with the text. Evaluation instrument(s): Daily quiz, Test I.

9. You will not be allowed references. You will outline basic wiring system installation procedures. Performance will be satisfactory if procedures are outlined and and theoutlining recieves a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I.

10. You will not be allowed references. You will explain electrical system modernizing techniques. Performance will be satisfactory if techniques are explained and the explanations are consistent with class instruction and texts. Evaluation instrument(s): Daily quiz; Test I.

11. You will be allowed references. You will analyze electrical trade catalogs. Performance will be satisfactory if catalogs are analyzed and the analysis recieves a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz, Test I.

12. You will be allowed references. You will interpret National Electrical Code requirements. Performance will be satisfactory if requirements are interpreted and the interpretations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz.

13. You will not be allowed references. You will interpret electrical symbols. Performance will be satisfactory if symbols are interpreted and the interpretations are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

14. You will not be allowed references. You will identify common electrical housing box requirements. Performance will be satisfactory if requirements are identified and the identifications are consistent with the text. Evaluation instrument(s): Daily quizzes, Test I.

15. You will not be allowed references. You will determine common household electrical service requirements. Performance will be satisfactory if requirements are determined and the determinations are consistent with class instruction and the text. Evaluation instrument(s): Daily quiz; Test II.

16. You will be allowed use of a calculator. You will solve electrical mathematics problems. Performance will be satisfactory if problems are solved and the solutions receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes; Tests I and II.

17. You will be allowed references and use of a calculator. You will calculate electrical project material and labor costs. Performance will be satisfactory if costs are calculated and each calculation is within +/-10% of true costs, as determined by your instructor. Evaluation instrument(s): Daily quizzes; Test II.

18. You will not be allowed references. You will identify various circuit and switch wiring principles. Performance will be satisfactory if principles are identified and the identifications are consistent with the text. Evaluation instrument(s): Daily quiz; Test II.

19. You will be allowed references. You will select electrical tools and equipment. Performance will be satisfactory if tools and equipment are selected and the selections are appropriate to the bab projects being performed. Evaluation instrument(s): Lab projects.

20. You will not be allowed references. You will outline electrical test equipment operational functions. Performance will be satisfactory if functions are outlined and the outlining is consistent with class instruction. Evaluation instrument(s): Daily quiz; Test II.

21. You will be allowed references. You will construct test boards. Performance will be satisfactory if test boards are constructed and the constructs receive a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

22. You will be allowed references. You will assemble common low-voltage electrical components. Performance will be satisfactory if components are assembled and the assemblies receive a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

23. You will be provided computer lab resourses and NEC software materials. You will complete computer-based (NEC) research assignments. Performance will be satisfactory if assignments are completed and the completions receive a satisfactory rating from your instructor. Evaluation instrument(s): Computer lab projects.

24. You will have access to the computer lab and the "Get Wired" software package. You will develop computer-based branch circuit wiring designs. Performance will be satisfactory if designs are developed and each design receives a satisfactory rating from your instructor. Evaluation instrument(s): Project assignments; Test II.

25. You will be allowed references. You will demonstrate effective reading and writing skills. Performance will be satisfactory if skills are demonstrated according to the DO/DON'T checklist developed for this course goal. Evaluation instrument(s): Test II.

26. You will be a member of ELE105. You will exhibit effective listening skills. Performance will be satisfactory if all of the items on the DO and DON'T list developed in class are met. Evaluation instrument(s): Test I.

27. You will be a member of ELE105. You will demonstrate cooperative interpersonal working characteristics. Performance will be satisfactory if all of the items on the DO and DON'T list developed in class are met. Evaluation instrument(s): Test II.

28. You will be allowed references and provided tools. You will perform electrical service projects. Performance will be satisfactory if projects are performed and and each performance recieves a satisfactory rating from your instructor, is consistent with NEC requirements, and each project is completed within any given time limits. Evaluation instrument: Lab project.

29. You will be allowed references. You will be provided tools. You will perform branch service projects. Performance will be satisfactory if projects are performed and each performance is consistent with given specifications. Evaluation instrument: Lab projects

30. You will perform a variety of circuit projects. Performance will be satisfactory if projects are performed and each performance receives a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

31. You will be allowed references. You will be provided test equipment. You will perform troubleshooting techniques. Performance will be satisfactory if techniques are performed as needed, and the performance receives a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

32. You will not be allowed references. You will be allowed to use a calculator. You will complete course Test I. Performance will be satisfactory if Test I is completed and the completing receives a rating of at least 70% and the test is completed in 90 minutes or less.

33. You will not be allowed references. You will complete course Test II. Performance will be satisfactory if Test II is completed and the completion receives a rating of at least 70%, and the test is completed in 90 minutes or less.

34. EXTRA CREDIT PROJECT. You will be allowed references. You will update the personal electrical-field career strategy developed at the beginning of this course. Up to 20 extra points may be added to your final grade based on your completion of this project.

ELE 105 / Revised May 6, 1995

BEST COPY AVAILABLE

North Lake College SCANS FOR ELE105 May 20, 1995	
SCANS COMPETENCIES	**Relevant Content Goals**
1. Managing Resources:	
a. Manage time	17.
b. Manage money	17.
c. Manage materials	17.
d. Manage space	
e. Manage staff	
2. Exhibiting Interpersonal Skills:	
a. Work on teams	27.
b. Teach others	
c. Serve customers	
d. Lead work teams	27.
e. Negotiate with others	27.
e. Work with different cultures	27.
3. Working with Information:	
a. Acquire/evaluate data	1, 3, 4, 11, 12, 13.
b. Organize/maintain information	1.
c. Interprete and communicate data	
d. Process information with computers	23, 24.
4. Applying Systems Knowledge:	
a. Work within social systems	
b. Work within technological systems	4, 5, 9, 14, 15, 17.
c. Work within organizational systems	2.
d. Monitor/correct system performance	
e. Design/improve systems	10, 24.
5. Using Technology:	
a. Select equipment & tools	5, 6, 7, 8, 19, 20.
b. Apply technology to specific tasks	21, 22, 28, 29, 30.
c. Maintain/troubleshoot technologies	31.

SCANS FOUNDATIONS	Relevant Content Goals
6. Demonstrating Basic Skills	
a. Reading	25.
b. Writing	25.
c. Arithmetic/Mathematics	16, 17.
d. Speaking	
e. Listening	26.
7. Demonstrating Thinking Skills	
a. Creative thinking	1.
b. Decision making	1.
c. Problem solving	
d. Seeing with the mind's eye	
e. Logical thinking	
8. Exhibiting Personal Qualities:	
a. Individual responsibility	1, 34.
b. Self-esteem	
c. Sociability	
d. Self-management	
e. Integrity	

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North Lake College
Curriculum Crosswalk:
ELE105 Content Goals and ACT Final Task List
May 8, 1995

Content Goal Statements	ACT Task List Reference Numbers
1. formulate personal electrical-field career strategy	
2. outline North Lake College campus support functions	
3. define basic electrical terms	
4. outline safe electrical working principles	7, 23, 41.
5. identify electrical conduit and raceway types	1.
6. specify common outlet receptacle uses	
7. differentiate common electrical switch types	
8. differentiate electrical conductors	31.
9. outline basic wiring system installation procedures	5.
10. explain electrical system modernizing techniques	32.
11. analyze electrical trade catalogs	
12. interpret National Electrical Code requirements	12, 16.
13. interpret electrical symbols	11, 18.
14. identify common electrical housing box requirements	
15. determine common household electrical service requirements	
16. solve electrical mathematics problems	20.
17. calculate electrical project material and labor costs	
18. identify various circuit and switch wiring principles	20.
19. select electrical tools and equipment	17, 37.
20. outline electrical test equipment operational functions	17, 21, 37.
21. construct test boards	21.
22. assemble common low-voltage electrical components	
23. complete computer-based (NEC) research assignments	
24. develop computer-based branch circuit wiring designs	
25. demonstrate effective reading and writing skills	16, 19, 23, 24, 25.

26. exhibit effective listening skills 27. demonstrate cooperative interpersonal working characteristics 28. perform electrical service projects 29. perform branch service projects 30. perform feeder circuit projects	2, 11. 2, 4, 27. 3, 6, 8, 9, 10, 14. 3, 6, 8, 9, 10, 14, 25. 3, 6, 8, 9, 10, 14, 25.
31. perform troubleshooting techniques 32. complete course Test I 33. complete course Test II 34. update personal electrical-field career strategy	28.

ELE105

Course Summary

	Cognitive		Psychomotor		Affective		Total
1	Fact	7 = 21%	Imitation	0 = 0%	Awareness	0 = 0%	7 = 21%
2	Understanding	15 = 44%	Practice	6 = 18%	Distinguish	3 = 9%	24 = 71%
3	Application	3 = 9%	Habit	0 = 0%	Integrate	0 = 0%	3 = 9%
		25 = 74%		6 = 18%		3 = 9%	

Frequency / Difficulty

	Low	High
High	21 = 62%	5 = 15%
Low	3 = 9%	5 = 15%

Purpose

Foundation	23 = 68%
Crucial	11 = 32%
Remediation	0 = 0%
Enrichment	0 = 0%

Agreement of Lecture and Lab Goals with Targets

Target Lecture Goals	28	Target Lab Goals	0
Actual Lecture Goals	6 = 18%	Actual Lab Goals	25 = 74%

North Lake College

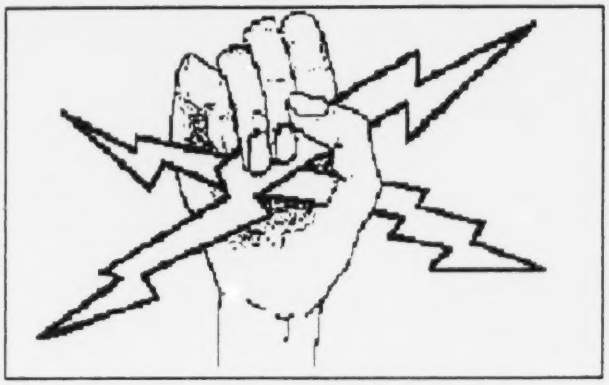
Technology Division

5001 N. MacArthur Blvd.
Irving, TX 75038-3899

Syllabus for

ELE115 (3 Hrs)
Low Voltage Circuits

Fall 1995



Course Description: *No prerequisites. This course focuses on types of low voltage electrical circuits. The theory, installation, and testing of low voltage circuits such as bells, chimes, and alarm systems will be presented. Laboratory fee. (2 Lec., 2 Lab.)*

Instructor Information	Class Schedule
Instructor: Larry Blevins **Office:** Room T-125 **Phone:** 659-5331 **Office Hours: MWF:** **T-Th:**	**Class Start Date:** **Location:** **Time:**

Texts and References:

1. Understanding and Servicing Alarm Systems; William Trimmer
2. National Electric Code; National Fire Protection Association
3. Low Voltage Circuits; Larry Blevins
4. Low Voltage Projects (Booklet); Larry Blevins

Course Goals *The following list of course goals will be addressed in the course. These goals are directly related to the performance objectives in Addendum A. (* designates a CRUCIAL goal)*	Point Value	Points Earned
1. demonstrate effective reading and writing skills	20	
*2. demonstrate safe working habits	20	
3. demonstrate cooperative interpersonal working characteristics	20	
4. describe transistor functional principles	10	
5. compare electron tube and transistor characteristics	20	

6.	describe various rectifier designs	10	
7.	identify automatic control system functional principles	10	
8.	determine rectifier requirements	20	
9.	outline direct current requirements	20	
10.	outline low voltage control system general characteristics	10	
11.	compare galvanic anode and impressed current anode systems	20	
12.	interpret resistor color band values	20	
13.	identify fire alarm system characteristics	10	
14.	describe heat detector operational principles	10	
15.	describe corrosion fundamentals	10	
16.	outline electromagnetic corrosion control methods	10	
17.	identify battery bank connection methods	10	
18.	create corrosion control system designs	30	
*19.	create wiring, schematic, and cable diagrams	30	
*20.	interpret National Electrical Code requirements	30	
*21.	solve electrical mathematics problems	30	
*22.	complete course Test I	100	
*23.	complete course Test II	100	
24.	select electrical tools and equipment	10	
*25.	outline safe electrical working principles	20	
26.	operate electrical measuring equipment	20	
27.	construct test boards	20	
28.	test resistors	20	
*29.	assemble common low-voltage electrical components	20	
*30.	perform lab assignments and projects	20	
*31.	verify electrical standard compliance	20	

Student Contributions:

You shoud spend approximately 4 hours per week preparing for class. Attendance is critical in this class.

Course Evaluation:

Your performance objectives and exams will be translated to points and the points to grades. There are 720 points possible and grades will be earned as follows: A=720 to 648, B=647 to 576, C=575 to 504, D=503 to 432.

Instructional Method

This course will be taught by a combination of self-study and lecture/discussion. Laboratory courses will include demonstration and hands-on tasks performed by students.

Attendance Policy

You are expected to attend class regularly and to consult with me whenever an absence is necessary. If you are unable to complete this course, you must withdraw from it by _____. Withdrawing from a course is a formal procedure which you must initiate; I cannot do it for you. You may do this in Admissions or Counseling. If you stop attending and do not withdraw, you will receive a performance grade, usually an "F".

The following rules will apply in any course where students participate in hands-on work assignments or tasks involving the use of tools and/or equipment in the laboratory:

- You will follow recognized safety practices.
- Posted safety rules will be followed.
- You will pass a safety test.
- Failure to comply with safety rules and repeatedly endangering yourself and/or other students will result in your removal from the course.
- Safety glasses are required to be worn when hazards to the eyes may exist. Glasses may be purchased at the North Lake College Bookstore.

Addendum A
Performance Objectives

1. You will be allowed references. You will demonstrate effective reading and writing skills. Performance will be satisfactory if skills are demonstrated according to the DO/DON'T checklist developed for this course goal. Evaluation instrument(s): Test II.

2. You will be a member of ELE115. You will demonstrate safe working habits. Performance will be satisfactory if all of the items on the DO and DON'T list developed in class are met. Evaluation instrument(s): Instructor checklist, Test II.

3. You will be a member of ELE105. You will demonstrate cooperative interpersonal working characteristics. Performance will be satisfactory if all of the items on the DO and DON'T list developed in class are met. Evaluation instrument(s): Test II.

4. You will not be allowed references. You will describe transistor functional principles. Performance will be satisfactory if principles are described and the descriptions are consistent with the text. Evaluation instrument(s): Daily quiz, Test I.

5. You will not be allowed references. You will compare electron tube and transistor characteristics. Performance will be satisfactory if characteristics are compared and the comparisons are consistent with the text. Evaluation instrument(s): Daily quiz, Test I.

6. You will not be allowed references. You will describe various rectifier designs. Performance will be satisfactory if designs are described and the descriptions are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

7. You will not be allowed references. You will identify automatic control system functional principles. Performance will be satisfactory if principles are identified and the identifications are consistent with the text. Evaluation instrument(s): Daily quiz, Test I.

8. You will not be allowed references. You will determine rectifier requirements. Performance will be satisfactory if requirements are determined and the determinations are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

9. You will not be allowed references. You will outline direct current requirements. Performance will be satisfactory if requirements are outlined and the outlines are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

10. You will not be allowed references. You will outline low voltage control system general characteristics. Performance will be satisfactory if characteristics are outlined and the outlining is/are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

11. You will not be allowed references. You will compare galvanic anode and impressed current anode systems. Performance will be satisfactory if systems are compared and the comparisons are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

12. You will not be allowed references. You will interpret resistor color band values. Performance will be satisfactory if values are interpreted and the interpretations are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

13. You will not be allowed references. You will identify fire alarm system characteristics. Performance will be satisfactory if characteristics are identified and the identifications are consistent with reference materials and the text. Evaluation instrument(s): Daily quiz; Test I.

14. You will not be allowed references. You will describe heat detector operational principles. Performance will be satisfactory if principles are described and the descriptions are consistent with reference materials and the text Evaluation instrument(s): Daily quiz; Test I.

15. You will not be allowed references. You will describe corrosion fundamentals. Performance will be satisfactory if fundamentals are described and the descriptions are consistent with the text. Evaluation instrument(s): Daily quiz; Test II.

16. You will not be allowed references. You will outline electromagnetic corrosion control methods. Performance will be satisfactory if methods are outlined and the outlining is consistent with the text. Evaluation instrument(s): Daily quiz; Test II.

17. You will not be allowed references. You will identify battery bank connection methods. Performance will be satisfactory if methods are identified and the identifications are consistent with the text. Evaluation instrument(s): Daily quiz; Test II.

18. You will not be allowed references. You will create corrosion control system designs. Performance will be satisfactory if designs are created and the designs receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz; Test II.

19. You will not be allowed references. You will create wiring, schematic, and cable diagrams. Performance will be satisfactory if diagrams are created and the designs receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz; Test II.

20. You will be allowed references. You will interpret National Electrical Code requirements. Performance will be satisfactory if requirements are interpreted and the interpretation is/are consistent with the National Electrical Code. Evaluation instrument: Daily quizzes

21. You will be allowed use of a calculator. You will solve electrical mathematics problems. Performance will be satisfactory if problems are solved and the solutions receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes; Tests I and II.

22. You will not be allowed references. You will be allowed to use a calculator. You will complete course Test I. Performance will be satisfactory if Test I is completed and the completing receives a rating of at least 70% and the test is completed in 90 minutes or less.

23. You will not be allowed references. You will complete course Test II. Performance will be satisfactory if Test II is completed and the completion receives a rating of at least 70%, and the test is completed in 90 minutes or less.

24. You will not be allowed references. You will select electrical tools and equipment. Performance will be satisfactory if appropriate tools and equipment are selected and the selections receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes; Test I.

25. You will not be allowed references. You will outline safe electrical working principles. Performance will be satisfactory if principles are outlined and the outlining is consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

26. You will not be allowed references. You will operate electrical measuring equipment. Performance will be satisfactory if equipment is operated and the operation receives a satisfactory rating from your instructor. Evaluation instrument(s): Instructor checklist.

27. You will be allowed references. You will construct test boards. Performance will be satisfactory if boards are constructed and the constructions receive a satisfactory rating from your instructor. Evaluation instrument(s): Instructor project checklist.

28. You will be allowed references and given test equipment. You will test resistors. Performance will be satisfactory if resistors are tested and the testing receives a satisfactory rating from your instructor s: Evaluation instrument(s): Instructor performance checklist, Test II.

29. You will be allowed references and given tools and materials. You will assemble common low-voltage electrical components. Performance will be satisfactory if components are assembled and the assemblies comply with National Electrical Code standards. Evaluation instrument(s): Lab assignments; Test II.

30. You will be provided equipment and materials. You will perform lab assignments and projects. Performance will be satisfactory if projects are performed and each project receives a satisfactory rating from your instructor. Evaluation instrument(s): Projects checklist.

31. You will be allowed references. You will verify electrical standard compliance. Performance will be satisfactory if compliance on each project is verified to the satisfaction of your instructor. Evaluation instrument(s): Instructor performance checklist, Test II

ELE 115 / Revised May 6, 1995

North Lake College SCANS FOR ELE115 May 20, 1995	
SCANS COMPETENCIES	**Relevant Content Goals**
1. Managing Resources:	
a. Manage time	
b. Manage money	
c. Manage materials	
d. Manage space	
e. Manage staff	
2. Exhibiting Interpersonal Skills:	
a. Work on teams	3.
b. Teach others	
c. Serve customers	
d. Lead work teams	3.
e. Negotiate with others	3.
e. Work with different cultures	3.
3. Working with Information:	
a. Acquire/evaluate data	4-17, 20, 25.
b. Organize/maintain information	
c. Interprete and communicate data	
d. Process information with computers	
4. Applying Systems Knowledge:	
a. Work within social systems	
b. Work within technological systems	2, 25, 27.
c. Work within organizational systems	
d. Monitoring/correct system performance	31.
e. Design/improve systems	18, 19, 27.
5. Using Technology:	
a. Select equipment & tools	24.
b. Apply technology to specific tasks	26, 27, 29, 30.
c. Maintain/troubleshoot technologies	28.

SCANS FOUNDATIONS	Relevant Content Goals
6. Demonstrating Basic Skills a. Reading b. Writing c. Arithmetic/Mathematics d. Speaking e. Listening	 1. 1. 21.
7. Demonstrating Thinking Skills a. Creative thinking b. Decision making c. Problem solving d. Seeing with the mind's eye e. Logical thinking	
8. Exhibiting Personal Qualities: a. Individual responsibility b. Self-esteem c. Sociability d. Self-management e. Integrity	

scan4cle.115

North Lake College
Curriculum Crosswalk:
ELE115 Content Goals and ACT Final Task List
May 8, 1995

Content Goal Statements	ACT Task List Reference Numbers
1. demonstrate effective reading and writing skills	16, 19, 23, 24, 25.
2. demonstrate safe working habits	7, 38, 41.
3. demonstrate cooperative interpersonal working characteristics	2, 4, 27.
4. describe transistor functional principles	20.
5. compare electron tube and transistor characteristics	20.
6. describe various rectifier designs	
7. identify automatic control system functional principles	
8. determine rectifier requirements	
9. outline direct current requirements	
10. outline low voltage control system general characteristics	
11. compare galvanic anode and impressed current anode systems	
12. interpret resistor color band values	
13. identify fire alarm system characteristics	
14. describe heat detector operational principles	
15. describe corrosion fundamentals	
16. outline electromagnetic corrosion control methods	
17. identify battery bank connection methods	
18. create corrosion control system designs	
19. create wiring, schematic, and cable diagrams	26.
20. interpret National Electrical Code requirements	12, 16.
21. solve electrical mathematics problems	
22. complete course Test I	
23. complete course Test II	
24. select electrical tools and equipment	17, 37.
25. outline safe electrical working principles	7, 23, 41.

26. operate electrical measuring equipment	15, 17, 29, 37.
27. construct test boards	21.
28. test resistors	40.
29. assemble common low-voltage electrical components	3, 40.
30. perform lab assignments and projects	3, 6, 8, 9, 10, 14, 25.
31. verify electrical standard compliance	16, 38.

ELE115

Course Summary

	Cognitive		Psychomotor		Affective		Total
1	Fact	9 = 29%	Imitation	0 = 0%	Awareness	0 = 0%	9 = 29%
2	Understanding	10 = 32%	Practice	5 = 16%	Distinguish	3 = 10%	18 = 58%
3	Application	4 = 13%	Habit	0 = 0%	Integrate	0 = 0%	4 = 13%
		23 = 74%		5 = 16%		3 = 10%	

Frequency / Difficulty

	Low	High
High	13 = 42%	4 = 13%
Low	11 = 35%	3 = 10%

Purpose

Foundation	21 = 68%
Crucial	10 = 32%
Remediation	0 = 0%
Enrichment	0 = 0%

Agreement of Lecture and Lab Goals with Targets

Target Lecture Goals	28	Target Lab Goals	14
Actual Lecture Goals	5 = 16%	Actual Lab Goals	23 = 74%

North Lake College

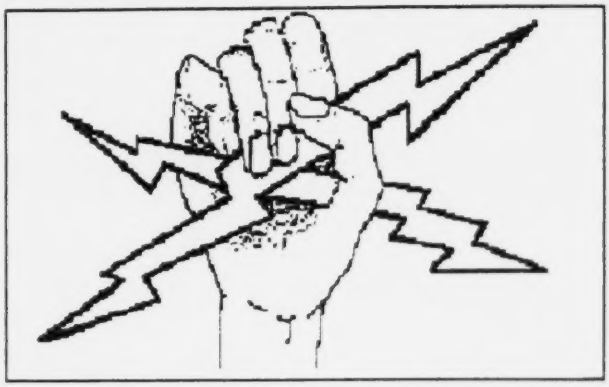
Technology Division

5001 N. MacArthur Blvd.
Irving, TX 75038-3899

Syllabus for

ELE116 (3 Hrs)
General Electrical Wiring

Fall 1995



Course Description: *No prerequisites. This course covers general wiring practices with emphasis on safety and procedures. Topics include materials selection, splicing, switches, receptacles, and lighting circuits for both residential and selected commercial applications. Laboratory fee. (2,Lec., 4 Lab.)*

Instructor Information		Class Schedule	
Instructor:	Larry Blevins	**Class Start Date:**	
Office:	Room T-125	**Location:**	
Phone:	659-5331	**Time:**	
Office Hours:	**MWF:**		
	T-Th:		

Texts and References:

1. National Electric Code; National Fire Protection Association
2. General Wiring Projects; Larry Blevins
3. Residential Wiring; Rockis
4. Design Forms, (Service, Feeder, Branch Circuits); Larry Blevins

Course Goals *The following list of course goals will be addressed in the course. These goals are directly related to the performance objectives in Addendum A. (* designates a CRUCIAL goal)*	Point Value	Points Earned
1. outline North Lake College campus support functions	10	
*2. apply effective communication skills	30	
*3. exhibit safe working habits	30	
4. demonstrate cooperative interpersonal working characteristics	20	
5. define basic electrical terms	10	

*6.	explain safe on-site electrical working requirements	20	
7.	interpret National Electrical Code requirements	20	
8.	differentiate common electrical components	10	
9.	specify electrical conductor requirements	10	
10.	identify various circuit and switch wiring principles	10	
11.	develop computer-based circuits	20	
12.	trace computer-based circuit pathways	20	
13.	identify common electrical tool and material requirements	10	
14.	explain basic electrical component installation procedures	20	
*15.	solve electrical mathematics problems	30	
*16.	interpret electrical drawings	20	
17.	determine common dwelling electrical service requirements	20	
*18.	complete course Test I	100	
*19.	complete course Test II	100	
20.	use common electrical test equipment	20	
21.	install branch circuits	50	
22.	install basic feeder circuits	50	
23.	perform lab assignments and projects	50	
24.	install residential electrical system components	50	
25.	build electrical service mockup	50	
26.	verify electrical standard compliance	20	
27.	update personal electrical-field career strategy	0-20	

Student Contributions:

You should spend approximately 4 hours a week preparing for class. Attendance is critical in this class.

Course Evaluation:

Your performance objective and exams will be translated to points and the points to grades. There are 800 points possible and grades will be earned as follows: A = 720 to 800, B = 640 to 719, C = 560 to 639, D = 480 to 559.

Instructional Method

This course will be taught by a combination of self-study and lecture/discussion. Laboratory courses will include demonstration and hands-on tasks performed by students.

Attendance Policy

You are expected to attend class regularly and to consult with me whenever an absence is necessary. If you are unable to complete this course, you must withdraw from it by _____. Withdrawing from a course is a formal procedure which you must initiate; I cannot do it for you. You may do this in Admissions or Counseling. If you stop attending and do not withdraw, you will receive a performance grade, usually an "F".

The following rules will apply in any course where students participate in hands-on work assignments or tasks involving the use of tools and/or equipment in the laboratory:

- You will follow recognized safety practices.
- Posted safety rules will be followed.
- You will pass a safety test.
- Failure to comply with safety rules and repeatedly endangering yourself and/or other students will result in your removal from the course.
- Safety glasses are required to be worn when hazards to the eyes may exist. Glasses may be purchased at the North Lake College Bookstore.

Addendum A
Performance Objectives

1. You will be allowed references. You will outline North Lake College campus support functions. Performance will be satisfactory if three major support functions are outlined and the module exercise for this assignment is completed by the 3rd class session.

2. You will be a member of ELE 116. You will apply effective communication skills. Performance will be satisfactory if skills are applied and the applications receive a satisfactory rating from your instructor Evaluation instrument(s): DO/DON'T Checklist.

3. You will be a member of ELE116. You will exhibit safe working habits. Performance will be satisfactory ONLY if ALL of the items on the DO/DON'T list developed for this course are FULLY MET. Evaluation instrument(s): Tests I and II.

4. You will be a member of ELE116. You will demonstrate cooperative interpersonal working characteristics. Performance will be satisfactory if all of the items on the DO/DON'T list developed in class are met.

5. You will not be allowed references. You will define basic electrical terms. Performance will be satisfactory if terms are defined and the definitions are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

6. You will not be allowed references. You will explain safe on-site electrical working requirements. Performance will be satisfactory if requirements are explained and the explanations are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

7. You will be allowed references. You will interpret National Electrical Code requirements. Performance will be satisfactory if requirements are interpreted and the interpretations are consistent with the National Electrical Code. Evaluation instrument(s): Daily quizzes, Lab projects.

8. You will be given examples. You will differentiate common electrical components. Performance will be satisfactory if components are differentiated and the differentiations are consistent with class information. Evaluation instrument(s): Daily quiz, Test I.

9. You will not be allowed references. You will specify electrical conductor requirements. Performance will be satisfactory if requirements are specified and the specifications are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

10. You will not be allowed references. You will identify various circuit and switch wiring principles. Performance will be satisfactory if principles are identified and the identifications are consistent with class instruction. Evaluation instrument(s): Daily quiz; Test I.

11. You will be allowed references and computer lab facilities. You will develop computer-based circuits. Performance will be satisfactory if circuits is/are developed s: receives a satisfactory rating from your instructor s: Evaluation instrument(s): Lab exercises.

12. You will be allowed references and provided computer lab facilities. You will trace computer-based circuit pathways. Performance will be satisfactory if pathways are traced and the traces receive a satisfactory rating from your instructor s: Evaluation instrument(s): Project review checklist, daily quizzes

13. You will not be allowed references. You will identify common electrical tool and material requirements. Performance will be satisfactory if requirements are identified and the identifications receive a satisfactory rating from your instructor. Evaluation instruments: Daily quizzes; Test II.

14. You will not be allowed references. You will explain basic electrical component installation procedures. Performance will be satisfactory if procedures are explained and the explanations are consistent with the text. Evaluation instrument(s): Daily quiz; Test II.

15. You will be allowed use of a calculator. You will solve electrical mathematics problems. Performance will be satisfactory if problems are solved and the solutions receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes; Tests I and II.

16. You will be allowed references. You will interpret electrical drawings. Performance will be satisfactory if drawings are interpreted and the interpretation are consistent with the text. Evaluation instrument(s): Daily quiz.

17. You will not be allowed references. You will determine common dwelling electrical service requirements. Performance will be satisfactory if requirements are determined and the determinations are consistent with NEC specifications. Evaluation instrument(s): Daily quiz; Test II.

18. You will not be allow references. You will be allowed to use a calculator. You will complete course Test I. Performance will be satisfactory if Test I is completed with a score of at least 70 points and the test is completed in 90 minutes or less.

19. You will not be allowed references. You will be allowed to use a calculator. You will complete course Test II. Performance will be satisfactory if Test II is completed with a score of at least 70 points and the test is completed in 90 minutes or less.

20. You will be provided tools. You will use common electrical test equipment. Performance will be satisfactory if equipment items are used, and their applications receive a satisfactory rating from your instructor s: Evaluation instrument(s): Project reviews, daily quizzes; Test II.

21. You will be allowed references and provided tools. You will install branch circuits. Performance will be satisfactory if circuits is/are installed and the installations receive a satisfactory rating from your instructor and circuits are installed in twice the flat rate time as published. Evaluation instrument(s): Project review checklist.

22. You will be allowed references and provided tools. You will install basic feeder circuits. Performance will be satisfactory if circuits are installed and the installations receive a satisfactory rating from your instructor and circuits are installed in twice the flat rate time as published s: Evaluation instrument(s): Project review checklist.

23. You will be provided equipment and materials. You will perform lab assignments and projects. Performance will be satisfactory if projects are performed and each project receives a satisfactory rating from your instructor. Evaluation instrument(s): Projects checklist

24. You will be allowed references and provided tools. You will install residential electrical system components. Performance will be satisfactory if components are installed and the installations receive a satisfactory rating from your instructor and components are installed in twice the flat rate time as published. Evaluation instrument(s): Project review checklist.

25. Students will be allowed references, tools, and materials. A team of students will build an electrical service mockup. Performance will be satisfactory if mockup is built and the building receives a perfect rating from your instructor. Evaluation instrument(s): Instructor checklist, Test II

26. You will be allowed references. You will verify electrical standard compliance. Performance will be satisfactory if compliance is verified according to the National Electrical Code standards. Evaluation instrument(s): Instructor verification of project assignments.

27. **EXTRA CREDIT PROJECT**. You will be allowed references. You will update the personal electrical-field career strategy developed at the beginning of this course. Up to 20 extra credit points may be added to your final course grade based on your completion of this project.

ELE116 / Revised May 6, 1995

North Lake College
SCANS FOR ELE116
May 24, 1995

SCANS COMPETENCIES	Relevant Content Goals
1. Managing Resources:	
a. Manage time	
b. Manage money	
c. Manage materials	
d. Manage space	
e. Manage staff	
2. Exhibiting Interpersonal Skills:	
a. Work on teams	4.
b. Teach others	
c. Serve customers	4.
d. Lead work teams	4.
e. Negotiate with others	4.
e. Work with different cultures	
3. Working with Information:	
a. Acquire/evaluate data	5, 16.
b. Organize/maintain information	
c. Interprete and communicate data	14.
d. Process information with computers	11, 12.
4. Applying Systems Knowledge:	
a. Work within social systems	
b. Work within technological systems	3, 6, 7, 11, 12, 20-25.
c. Work within organizational systems	
d. Monitoring/correct system performance	
e. Design/improve systems	11, 25.
5. Using Technology:	
a. Select equipment & tools	8, 9, 13, 20.
b. Apply technology to specific tasks	10, 11, 12, 20-25.
c. Maintain/troubleshoot technologies	26.

SCANS FOUNDATIONS	Relevant Content Goals
6. Demonstrating Basic Skills	
a. Reading	2.
b. Writing	2.
c. Arithmetic/Mathematics	15.
d. Speaking	2.
e. Listening	2.
7. Demonstrating Thinking Skills	
a. Creative thinking	
b. Decision making	17.
c. Problem solving	17.
d. Seeing with the mind's eye	16.
e. Logical thinking	
8. Exhibiting Personal Qualities:	
a. Individual responsibility	27.
b. Self-esteem	
c. Sociability	
d. Self-management	
e. Integrity	

North Lake College
Curriculum Crosswalk:
ELE 116 Content Goals and ACT Final Task List
May 12, 1995

Content Goal Statements	ACT Task List Reference Numbers
1. outline North Lake College campus support functions	
2. apply effective communication skills	24, 25, 30.
3. exhibit safe working habits	7, 38, 41.
4. demonstrate cooperative interpersonal working characteristics	2, 4, 27.
5. define basic electrical terms	
6. explain safe on-site electrical working requirements	7, 12, 23, 32, 38, 41.
7. interpret National Electrical Code requirements	16.
8. differentiate common electrical components	
9. specify electrical conductor requirements	31.
10. identify various circuit and switch wiring principles	20.
11. develop computer-based circuits	
12. trace computer-based circuit pathways	
13. identify common electrical tool and material requirements	17.
14. explain basic electrical component installation procedures	5, 32, 36, 39.
15. solve electrical mathematics problems	
16. interpret electrical drawings	11, 18, 26.
17. determine common dwelling electrical service requirements	
18. complete course Test I	
19. complete course Test II	
20. use common electrical test equipment	17, 21, 37, 40, 42.
21. install branch circuits	3, 5, 9, 10, 13, 22.
22. install basic feeder circuits	3, 5, 9, 10, 13, 22, 35, 36.
23. perform lab assignments and projects	3, 6, 8, 9, 10, 13, 14, 22, 25, 36.
24. install residential electrical system components	1, 5, 9, 10, 13, 22, 35, 36, 40.
25. build electrical service mockup	1, 8, 9, 10, 13, 14, 22, 35, 36.

26. verify electrical standard compliance 27. update personal electrical-field career strategy	16, 38,

ELE116

Course Summary

	Cognitive		Psychomotor		Affective		Total
1	Fact	6 = 22%	Imitation	0 = 0%	Awareness	0 = 0%	6 = 22%
2	Understanding	9 = 33%	Practice	7 = 26%	Distinguish	1 = 4%	17 = 63%
3	Application	3 = 11%	Habit	0 = 0%	Integrate	1 = 4%	4 = 15%
		18 = 67%		7 = 26%		2 = 7%	

Frequency / Difficulty

	Low	High
High	15 = 56%	6 = 22%
Low	2 = 7%	4 = 15%

Purpose

Foundation	18 = 67%
Crucial	8 = 30%
Remediation	0 = 0%
Enrichment	1 = 4%

Agreement of Lecture and Lab Goals with Targets

Target Lecture Goals	14	Target Lab Goals	28
Actual Lecture Goals	7 = 26%	Actual Lab Goals	18 = 67%

North Lake College

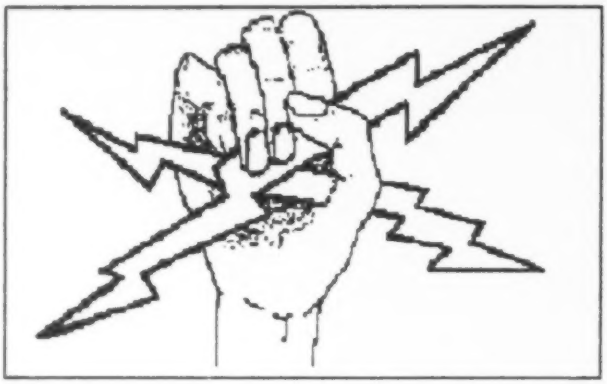
Technology Division

5001 N. MacArthur Blvd.
Irving, TX 75038-3899

Syllabus for

ELE206 (4 Hrs)
Commercial Planning

Fall 1995



Course Description: *No prerequisites. This course stresses application for service feeders and branch circuits for commercial loads. Topics covered include blueprint reading, load calculations, overload protection, and planning for selected commercial environments. Laboratory fee. (4 Lec., 2 Lab.)*

Instructor Information	Class Schedule
Instructor: Larry Blevins **Office:** Room T-125 **Phone:** 659-5331 **Office Hours: MWF:** **T-Th:**	**Class Start Date:** **Location:** **Time:**

Texts and References:

1. Electrical Wiring Commercial; Mullen and Smith
2. National Electrical Code; National Fire Protection Association.
3. Comercial Planning Project (Work book); Larry Blevins
4. Design Forms (Service, feeder, branch circuits); Larry Blevins

Course Goals *The following list of course goals will be addressed in the course. These goals are directly related to the performance objectives in Addendum A. (* designates a CRUCIAL goal)*	Point Value	Points Earned
1. recall North Lake College campus support functions	10	
*2. apply effective reading, writing, speaking, and listening skills	20	
3. recall safe electrical working principles	10	
4. recall National Electrical Code requirements	10	
5. recall electrical blueprint symbols	10	

6.	interpret commercial building plan specifications	20	
7.	read commercial building plan blueprints	20	
8.	define lamp and lighting terms	10	
9.	recall electrical system modernizing techniques	10	
10.	verify common electrical switch, receptacle, and application rating compatibility	10	
11.	describe miscellaneous owner-controlled circuit and switch installation requirements	10	
12.	perform panel board modifications	20	
13.	cite city code and other organization's electrical standards	10	
14.	demonstrate general mathematics skills	30	
*15.	calculate electrical load and branch circuit requirements	20	
16.	perform conductor withstand rating calculations	20	
17.	make short-circuit calculations	20	
18.	assemble branch-circuit installation materials	20	
*19.	organize basic electrical service activities	20	
20.	describe cooling system components and functions	10	
21.	calculate cooling system requirements	20	
22.	identify low-voltage remote-control wiring components	10	
23.	perform low-voltage remote-control installations	30	
24.	determine fuse and circuit breaker overcurrent protection requirements	20	
25.	analyze time-current curves	20	
26.	select emergency power systems	20	
27.	install emergency power systems	30	
28.	recall automatic control system functional principles	10	
*29.	complete course Test I	100	
*30.	complete course Test II	100	
31.	recall fire alarm system characteristics	10	
32.	perform special system conduit and circuit installations	30	
33.	install transformer and grounding systems	30	
34.	explain major appliance wiring installation methodologies	20	
*35.	prescribe appliance branch-circuit wiring and grounding specifications	20	

36.	plan electrical conduit and component layouts	20	
37.	select branch-circuit installation materials	20	
*38.	analyze commercial contract documents	30	
39.	determine commercial project completion timelines	30	
40.	develop commercial project cost analysis	30	
*41.	demonstrate safe electrical working techniques	20	
42.	validate personal electrical-field career plan	0-20	

Student Contributions:

Each student will spend at least 3 hours per week preparing for class. Attendance is critical in this class.

Course Evaluation:

Your performance objective and exams will be translated to points and the points to grades. There are 930 points possible and grades will be earned as follows: A = 837 to 930, B = 744 to 836, C = 651 to 743, D = 558 to 650.

Instructional Method

This course will be taught by a combination of self-study and lecture/discussion. Laboratory courses will include demonstration and hands-on tasks performed by students.

Attendance Policy

You are expected to attend class regularly and to consult with me whenever an absence is necessary. If you are unable to complete this course, you must withdraw from it by _____. Withdrawing from a course is a formal procedure which you must initiate; I cannot do it for you. You may do this in Admissions or Counseling. If you stop attending and do not withdraw, you will receive a performance grade, usually an "F".

A Few Words *About*

«««SAFETY»»»

The following rules will apply in any course where students participate in hands-on work assignments or tasks involving the use of tools and/or equipment in the laboratory:

- You will follow recognized safety practices.
- Posted safety rules will be followed.
- You will pass a safety test.
- Failure to comply with safety rules and repeatedly endangering yourself and/or other students will result in your removal from the course.
- Safety glasses are required to be worn when hazards to the eyes may exist. Glasses may be purchased at the North Lake College Bookstore.

Addendum A
Performance Objectives

1. You will be allowed references. You will recall North Lake College campus support functions. Performance will be satisfactory if the module exercise for this assignment is completed by the 3rd class session and receives a satisfactory rating from your instructor.

2. You will be allowed references. You will apply effective reading, writing, speaking, and listening skills. Performance will be satisfactory if skills are applied and the applications receive a satisfactory rating from your instructor. Evaluation instrument(s): Performance checklist on Test II.

3. You will be allowed references. You will recall safe electrical working principles. Performance will be satisfactory if principles are recalled and the recall is consistent with the text, Electrical Wiring Commercial and the module exercise for this assignment is completed by the 4th class session, and it receives a satisfactory rating from your instructor.

4. You will be allowed references. You will recall National Electrical Code requirements. Performance will be satisfactory if requirements are recalled and the recalls are consistent with the NEC Standards. Evaluation instrument(s): Daily quizzes.

5. You will not be allowed references. You will recall electrical blueprint symbols. Performance will be satisfactory if symbols are recalled and the recalls are consistent with the text. Evaluation instrument(s): Daily quizzes; Tests I and II.

6. You will not be allowed references. You will interpret commercial building plan specifications. Performance will be satisfactory if specifications are interpreted and the interpretations are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

7. You will be allowed references. You will read commercial building plan blueprints. Performance will be satisfactory if blueprints are read and the readings receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes.

8. You will not be allowed references. You will define lamp and lighting terms. Performance will be satisfactory if terms are defined and the definitions are consistent with the text. Evaluation instrument(s): Daily quiz; Test I.

9. You will not be allowed references. You will recall electrical system modernizing techniques. Performance will be satisfactory if techniques are recalled and the recalls are consistent with classroom instruction and the text. Evaluation instrument(s): Daily quiz; Test II.

10. You will be allowed references. You will verify common electrical switch, receptacle, and application rating compatibility. Performance will be satisfactory if compatibility is verified and the verification receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quiz; Test I.

11. You will be allowed references. You will describe miscellaneous owner-controlled circuit and switch installation requirements. Performance will be satisfactory if requirements are described and the descriptions receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I.

12. You will be allowed references. You will perform panel board modifications. Performance will be satisfactory if modifications are performed and each performance receives a satisfactory rating from your instructor. Evaluation instrument: Lab projects.

13. You will be allowed references. You will cite city code and other organization's electrical standards. Performance will be satisfactory if standards are cited and the citations are consistent with reference materials. Evaluation instrument(s): Daily quiz, Test II.

14. You will be allowed references. You will demonstrate general mathematics skills. Performance will be satisfactory if skills are demonstrated and the calculations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Tests I and II, and Lab projects.

15. You will be allowed references. You will calculate electrical load and branch circuit requirements. Performance will be satisfactory if requirements are calculated and the calculations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I, Lab project.

16. You will be allowed references. You will perform conductor withstand rating calculations. Performance will be satisfactory if calculations are performed and the performance receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I.

17. You will be allowed references. You will make short-circuit calculations. Performance will be satisfactory if calculations are made and the calculations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I.

18. You will be allowed references. You will assemble branch-circuit installation materials. Performance will be satisfactory if materials are assembled and the assembly receives a satisfactory rating from your instructor.

19. You will be allowed references. You will organize basic electrical service activities. Performance will be satisfactory if activities are organized and the organizing receives a satisfactory rating from your instructor. Evaluation instrument(s): Instructor's Performance Checklist

20. You will be allowed references. You will describe cooling system components and functions. Performance will be satisfactory if functions are described and the descriptions receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I, Lab project.

21. You will be allowed references. You will calculate cooling system requirements. Performance will be satisfactory if requirements are calculated and the calculations receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I, Lab project.

22. You will not be allowed references. You will identify low-voltage remote-control wiring components. Performance will be satisfactory if components are identified and the identifications are consistent with the text. Evaluation instrument(s): Daily quizzes, Test I.

23. You will be allowed references and provided tools and materials. You will perform low-voltage remote-control installations. Performance will be satisfactory if installations are performed and the performance meets specifications. Evaluation instrument(s): Lab projects.

24. You will be allowed references. You will determine fuse and circuit breaker overcurrent protection requirements. Performance will be satisfactory if requirements are determined and the determinations are consistent with the text. Evaluation instrument(s): Daily quizzes, Test II.

25. You will be allowed references. You will analyze time-current curves. Performance will be satisfactory if curves/are analyzed and the analysis receives a satisfactory rating from your instructor. evaluation instrument(s): Quiz and Test I.

26. You will be allowed references and given specifications. You will select emergency power systems. Performance will be satisfactory if systems are selected and the selections meet specification requirements. Evaluation instrument(s): Daily quizzes, Test II.

27. You will be allowed references. You will be provided tools and materials. You will install emergency power systems. Performance will be satisfactory if systems are installed and each installation receives a satisfactory rating from your instructor and systems are installed in twice the flat rate time as published and the installation of the systems endures for the time specified by your instructor. Evaluation instrument(s): Lab projects.

28. You will be allowed references. You will recall automatic control system functional principles. Performance will be satisfactory if principles are recalled and the recalls receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I Lab project.

29. You will not be allowed references. You will be allowed to use a calculator. You will complete course Test I. Performance will be satisfactory if Test I is completed and the completing receives a rating of at least 70% and the test is completed in 90 minutes or less.

30. You will not be allowed references. You will complete course Test II. Performance will be satisfactory if Test II is completed and the completion receives a rating of at least 70%.

31. You will be allowed references. You will recall fire alarm system characteristics. Performance will be satisfactory if characteristics are recalled and the recall receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I.

32. You will be allowed references and provided tools and materials. You will perform special system conduit and circuit installations. Performance will be satisfactory if installations are performed and each performance receives a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

33. You will be allowed references and provided tools and materials. You will install transformer and grounding systems. Performance will be satisfactory if systems are installed and each installation receives a satisfactory rating from your instructor. Evaluation instrument(s): Lab projects.

34. You will be allowed references. You will explain major appliance wiring installation methodologies. Performance will be satisfactory if methodologies are explained and the explanations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test II.

35. You will be allowed references. You will prescribe appliance branch-circuit wiring and grounding specifications. Performance will be satisfactory if specifications are prescribed and each prescription is consistent with the text. Evaluation instrument(s): Daily quizzes, Test II.

36. You will be allowed references. You will plan electrical conduit and component layouts. Performance will be satisfactory if layouts are planned and each plan receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test I , Lab projects.

37. You will be allowed references and given specifications. You will select branch-circuit installation materials. Performance will be satisfactory if materials are selected and the selections meet stated specifications. Evaluation instruments: Daily quiz, Test II.

38. You will be allowed references. You will analyze commercial contract documents. Performance will be satisfactory if documents are analyzed and the analysis receives a satisfactory rating from your instructor.

39. You will be allowed references. You will determine commercial project completion timelines. Performance will be satisfactory if timelines are determined and the determinations receive a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test II.

40. You will be allowed references. You will develop commercial project cost analysis. Performance will be satisfactory if analysis is developed and receives a satisfactory rating from your instructor. Evaluation instrument(s): Daily quizzes, Test II.

41. You will be a member of ELE206. You will demonstrate safe electrical working techniques. Performance will be satisfactory if all of the items on the DO and DON'T list developed for this class are met.

42. You will be allowed references. You will validate personal electrical-field career plan. Performance will be satisfactory if your previously-developed plan is validated and the validation receives a satisfactory rating from your instructor. Evaluation instrument: Project review checklist (see your instructor for details).

ELE206 / Revised May 6, 1995

North Lake College
SCANS FOR ELE206
May 24, 1995

SCANS COMPETENCIES	Relevant Content Goals
1. Managing Resources:	
a. Manage time	39.
b. Manage money	40.
c. Manage materials	
d. Manage space	
e. Manage staff	
2. Exhibiting Interpersonal Skills:	
a. Work on teams	
b. Teach others	
c. Serve customers	19.
d. Lead work teams	
e. Negotiate with others	19, 38.
e. Work with different cultures	
3. Working with Information:	
a. Acquire/evaluate data	6, 7, 14-17, 20, 21, 28, 35, 38.
b. Organize/maintain information	36, 40.
c. Interprete and communicate data	
d. Process information with computers	
4. Applying Systems Knowledge:	
a. Work within social systems	
b. Work within technological systems	3, 4, 5, 9, 10, 11, 22, 31, 41.
c. Work within organizational systems	13.
d. Monitoring/correct system performance	
e. Design/improve systems	36.
5. Using Technology:	
a. Select equipment & tools	37.
b. Apply technology to specific tasks	10, 11, 12, 18, 23, 27, 32, 33.
c. Maintain/troubleshoot technologies	

SCANS FOUNDATIONS	Relevant Content Goals
6. Demonstrating Basic Skills	
a. Reading	2.
b. Writing	2.
c. Arithmetic/Mathematics	14, 15, 16, 17, 21.
d. Speaking	2.
e. Listening	2.
7. Demonstrating Thinking Skills	
a. Creative thinking	
b. Decision making	24, 26, 34, 35.
c. Problem solving	24, 26, 34, 35.
d. Seeing with the mind's eye	25, 34.
e. Logical thinking	
8. Exhibiting Personal Qualities:	
a. Individual responsibility	42.
b. Self-esteem	
c. Sociability	
d. Self-management	
e. Integrity	

North Lake College
Curriculum Crosswalk:
ELE 206 Content Goals and ACT Final Task List
May 15, 1995

Content Goal Statements	ACT Task List Reference Numbers
1. recall North Lake College campus support functions	
2. apply effective reading, writing, speaking, and listening skills	11, 16, 19, 23, 24, 25, 30.
3. recall safe electrical working principles	7, 23, 41.
4. recall National Electrical Code requirements	12, 16.
5. recall electrical blueprint symbols	11.
6. interpret commercial building plan specifications	11, 18.
7. read commercial building plan blueprints	11, 16, 18, 19, 26.
8. define lamp and lighting terms	
9. recall electrical system modernizing techniques	
10. verify common electrical switch, receptacle, and application rating compatibility	38.
11. describe miscellaneous owner-controlled circuit and switch installation requirements	
12. perform panel board modifications	
13. cite city code and other organization's electrical standards	12, 16.
14. demonstrate general mathematics skills	
15. calculate electrical load and branch circuit requirements	
16. perform conductor withstand rating calculations	31.
17. make short-circuit calculations	
18. assemble branch-circuit installation materials	3, 5, 9, 10, 13, 22.
19. organize basic electrical service activities	
20. describe cooling system components and functions	40.
21. calculate cooling system requirements	
22. identify low-voltage remote-control wiring components	
23. perform low-voltage remote-control installations	5, 6, 8, 9, 10, 13, 14.
24. determine fuse and circuit breaker overcurrent protection requirements	
25. analyze time-current curves	21.

26. select emergency power systems 27. install emergency power systems 28. recall automatic control system functional principles 29. complete course Test I 30. complete course Test II	9, 10, 13, 22.
31. recall fire alarm system characteristics 32. perform special system conduit and circuit installations 33. install transformer and grounding systems 34. explain major appliance wiring installation methodologies 35. prescribe appliance branch-circuit wiring and grounding specifications	1, 3, 6, 8, 9, 10, 13, 14, 22. 25, 33. 9, 10, 36. 32, 39. 32, 42.
36. plan electrical conduit and component layouts 37. select branch-circuit installation materials 38. analyze commercial contract documents 39. determine commercial project completion timelines 40. develop commercial project cost analysis	12, 13, 33. 13.
41. demonstrate safe electrical working techniques 42. validate personal electrical-field career plan	7, 38, 41.

ELE206

Course Summary

	Cognitive		Psychomotor		Affective		Total
1	Fact	10 = 24%	Imitation	0 = 0%	Awareness	0 = 0%	10 = 24%
2	Understanding	13 = 31%	Practice	7 = 17%	Distinguish	0 = 0%	20 = 48%
3	Application	11 = 26%	Habit	0 = 0%	Integrate	1 = 2%	12 = 29%
		34 = 81%		7 = 17%		1 = 2%	

Frequency / Difficulty

	Low	High
High	16 = 38%	8 = 19%
Low	4 = 10%	14 = 33%

Purpose

Foundation	25 = 60%
Crucial	8 = 19%
Remediation	8 = 19%
Enrichment	1 = 2%

Agreement of Lecture and Lab Goals with Targets

Target Lecture Goals	42	Target Lab Goals	14
Actual Lecture Goals	7 = 17%	Actual Lab Goals	34 = 81%

ACT Work Keys Final Task List

NOTE: Underlined task numbers are not referenced to any content goals for ELE 105/115/116/206

1. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools such as hacksaws, pipe threaders, and conduit benders.

2. Works and coordinates with others (including people practicing other crafts) to complete assigned projects.

3. Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of a foreman.

4. Provides prompt and efficient service to customers by responding quickly to customer work orders.

5. Connects wiring to accessories, such as relays, circuit breakers, plugs, condensers, switches, and solenoids; and installs accessory assemblies in electrical or electronic units using soldering gun and hand tools.

6. Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools.

7. Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as grounding line equipment and jumpers.

8. Connects conductors to switches, receptacles, or appliances with proper methods of splicing or soldering and taping.

9. Connects wiring to lighting fixtures and power equipment using hand tools.

10. Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.

11. Lays the various outlets, switches, receptacles, and other details of the job from blueprints or by direction of the superintendent of construction.

12. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes.

13. Plans, lays out, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment using hand tools and power tools.

14. Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wire together, and applying tape or terminal caps or necessary lugs.

15. Uses measuring instruments, such a as rulers, plumb-bobs, levels, and wire gauges.

16. Reads and understands construction standards manual and is familiar with electrical codes.

17. Uses measuring instruments such as volt meters, ohm meters, and amp meters.

18. Interprets maintenance manuals, schematics, and wiring diagrams, and repairs equipment, utilizing knowledge of electronics and using standard test instruments using hand tools and power tools.

19. Reads work order to determine installation procedures specified by supervisor/technician.

20. Studies and understands electrical theory (Ohm's law; single-phase and three-phase circuits; and vectors, voltage drops, series and parallel circuits).

21. Tests circuits and electric components to locate grounded wires, broken connections, or detective current-control mechanisms using electrical testing instruments.

22. Installs and connects single-phase and three-phase bank transformer connections and capacitor banks/voltage regulators.

23. Attends regular safety meetings and reads distributed material regarding new safety procedures.

24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets.

25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork.

26. Prepares sketches or as-built drawings showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring.

27. Suggests improvements in work methods by reviewing current procedures and using on-the-job experience to make tasks more efficient.

28. Troubleshoots, repairs, and maintains, in accordance with diagrams, sketches, operation manuals, and manufacturer's specifications, machinery and equipment, such as transformers, tools, regulators, reclosers, capacitors, switches, fuses, and cut-outs.

29. Takes measurements, such as street and building dimensions, distances to be spanned by wire and cable, or space available in existing buildings and underground vaults, which affect installation and arrangement of equipment.

30. Operate radio to communicate with co-workers and dispatchers.

31. Recognizes and identifies the wide variety of conductors, such as underground and overhead.

32. Assesses work environment for proper wiring methods and materials and hazardous locations.

33. Digs trench and lays underground cable and conduit to connect source of power to customer's building, setup outdoor lighting as well as laying underground cable and conduit for data and communications (commercial, industrial, and residential).

34. Drives and operates vehicles and equipment, such as trucks (may be required to have commercial driver's license), trenchers, and tractors.

35. Installs and replaces duct systems and underground cable (works in underground vaults where cables are located).

36. Installs, maintains, and repairs pedestals, equipment pads, switching cabinets, pad-mounted transformers, and other underground equipment.

37. Locates cable and faults using fault and/or cable locating equipment.

38. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.

39. Removes obstructions (steel structures, manhole covers, substation enclosures) and material in order to gain access to and remove defective parts or perform maintenance, using hoists, personnel lifts, cranes, hand tools and power tools.

40. Replaces defective components and parts, such as transistors, coils, and integrated circuits, using soldering iron, wire cutters, hand tools, and power tools.

41. Works on energized lines with rubber gloves, mats, and blankets and/or live line tools.

42. Terminates, splices, and tests cable according to manufacturing specifications.

43. Uses transit and tripod to establish grade and elevation.

44. Cuts and welds steel structural members using flame cutting and welding equipment.

Product B:

Review of interim Electrical Construction Occupation Descriptions

paired with SCANS

Electrical Residential Construction Worker Duties Paired with SCANS/Workplace Skills

SCANS/WORKPLACE SKILLS	AM	AT	RI	LI	TW	L	W
Duties: Electrical Residential Construction Worker							
Planning/Initiating Project	x	x	x	x	x	x	x
Establishing Temporary Power During Construction	x	x	x	x	x	x	x
Establishing Grounding System	x	x	x	x	x	x	x
Installing Underground System (Slab/Foundation)	x	x	x	x	x	x	x
Rough-in	x	x	x	x	x	x	x
Run Wire	x	x	x	x	x	x	x
Trim Out	x	x	x	x	x	x	x
Perform Hot Checks	x	x	x	x	x	x	x
Troubleshooting and Repairing Electrical Systems	x	x	x	x	x	x	x
Supervising ERCW and Apprentices	x	x	x	x	x	x	x
Install Service Extension (Utility Company)	x	x	x	x	x	x	x
Establishing OSHA and Customer Safety Requirements	x	x	x	x	x	x	x
Installing Swimming Pool Equipment	x	x	x	x	x	x	x
Installing, Maintaining, and Repairing Security Systems	x	x	x	x	x	x	x
Installation of Home Automation/Energy Management Systems	x	x	x	x	x	x	x

AM = Applied Math; AT = Applied Technology; RI = Reading for Information
LI =Locating Information; T = Teamwork; L = Listening; W = Writing

Duties Source: U.S. Electrical construction Industry Skill Standards and Certification Project document, "Electrical Construction Occupations: Interim Job Descriptions and KSA Lists for Electrical Construction Worker, Electrical Line Construction Worker and Electrical Residential Construction Worker," January, 1995.
Matrix completed by A.C. McAfee, Dallas Electrical Joint Apprenticeship Training Prog Director

Electrical Line Construction Worker Duties Paired with SCANS/Workplace Skills

SCANS/WORKPLACE SKILLS	AM	AT	RI	LI	TW	L	W
Duties: Electrical Line Construction Worker							
Planning/Initiating Project	x	x	x	x	x	x	x
Establishing OSHA and Customer Safety Requirements	x		x	x	x	x	x
Setting of Towers, Poles and Construction of Other Devices to Hold Electrical Wiring	x	x	x	x	x	x	x
Establishing Work Position for Maintaining and Repairing Overhead Distribution or Transmission Lines	x	x	x	x	x	x	x
Stringing New Wire or Maintaining Old Wire		x	x	x	x	x	x
Installing and Maintaining Insulators		x			x		
Installing and Maintaining Transformers and Other Equipment	x	x	x	x	x	x	x
Supervising ELCW and Apprentices	x	x	x	x	x	x	x
Installing, Repairing, and Maintaining an Underground Electrical Distribution System	x	x	x	x	x	x	x
Assembly and Erection of Substations	x	x	x	x	x	x	x
Installing, Maintaining and Repairing Traffic or Train Signals and Outdoor Lighting	x	x	x	x	x	x	x
Tree Trimming		x			x		

AM = Applied Math; AT = Applied Technology; RI = Reading for Information
LI =Locating Information; T = Teamwork; L = Listening; W = Writing

Duties Source: U.S. Electrical Construction Industry Skill Standards and Certification Project document, "Electrical Construction Occupations: Interim Job Descriptions and KSA Lists for Electrical Construction Workder, Electrical Line Construction Worker, and Electrical Residential Construction Worker," January, 1995.
Matrix completed by A.C. McAfee, Dallas Elecrical Joint Apprenticeship Program Director

Electrical Construction Worker Duties Paired with SCANS/Workplace Skills

SCANS/WORKPLACE SKILLS	AM	AT	RI	LI	TW	L	W
Duties: Electrical Construction Worker							
Planning/Initiating Project	x	x	x	x	x	x	x
Establishing Temporary Power during construction	x	x	x	x	x	x	x
Establishing Grounding System	x	x	x	x	x	x	x
Installing Service to Buildings and Other Structures	x	x	x	x	x	x	x
Establishing Power Distribution within Project	x	x	x	x	x	x	x
Planning and Installing Raceway Systems	x	x	x	x	x	x	x
Installing New Wiring and Repairing Old Wiring	x	x	x	x	x	x	x
Providing Power and Controls to Motors, HVAC, and Other Equipment	x	x	x	x	x	x	x
Installing Receptacles, Lighting Systems and Fixtures	x	x	x	x	x	x	x
Troubleshooting and Repairing Electrical Systems	x	x	x	x	x	x	x
Installing and Repairing Traffic Signals, Outdoor Lighting, and Outdoor Power Feeders	x	x	x	x	x	x	x
Installing Fire Alarm Systems	x	x	x	x	x	x	x
Supervising ECW and Apprentices	x	x	x	x	x	x	x
Establishing OSHA and Customer Safety Requirements	x	x	x	x	x	x	x
Installing Instrumentation and Process Control Systems, Including Energy Management Systems	x	x	x	x	x	x	x
Erecting and Assembling power Generation Equipment	x	x	x	x	x	x	x

SCANS/WORKPLACE SKILLS	AM	AT	RI	LI	TW	L	W
Installing Security Systems	x	x	x	x	x	x	x
Installing, Maintaining and Repairing Lightning Protection Systems	x	x	x	x	x	x	x
Installing and Repairing Telephone and Data Systems	x	x	x	x	x	x	x

AM = Applied Math; AT = Applied Technology; RI = Reading for Information
LI =Locating Information; T = Teamwork; L = Listening; W = Writing

Duties Source: U.S. Electrical Construction Industry Skill Standards and Certification Project document, "Electrical Construction Occupations," January, 1995.

SCANS/Workplace Skills Crosswalk completed by A.C. McAfee, Dallas Electrical Joint Apprenticeship Training Program, May, 1995.

Product C:

Electrical Technology Competency Profile

STUDENT DATA PROFILE Electrical Technology		
Student Data	Name:	SSAN:
	Address:	
	Work Phone: ( )	Home Phone: ( )
Emergency Data	Emergency Contact:	Phone: ( )
	Doctor:	Phone: ( )
	Special Needs:	

Educational Objective	A.A.S. _____	Cert.: _____	Other: _____

Course	Date(s) Enrolled, Completed, Withdrew	Final Grade	Instructor Initials
ELE 105 Introduction to Electrical Technology			
ELE 106 Fundamentals of Electricity			
ELE 107 Electrical Transformers			
ELE 108 General Electrical Codes			
ELE 115 Low Voltage Circuits			
ELE 116 General Electrical Planning			
ELE 117 General Electrical Planning			
ELE 118 Commercial Codes			
ELE 205 Commercial Wiring			
ELE 206 Commercial Planning			
ELE 207 Industrial Planning			
ELE 208 Industrial Codes			
ELE 213 Electrical Motor Fundamentals			
ELE 214 Solid State Controls			
ELE 216 Motor Controls			
ELE 218 Electrical Design			
ELE 7XX/8XX Cooperative Work Experience			

COMPETENCY PROFILE: ELE 105							
Category	**Content Goal**	**Proficiency Rating** Poor Average Superior				
Resource Management Proficiency	17. calculate electrical project material and labor costs	1	2	3	4	5
Personal and Interpersonal Skill Proficiency	1. formulate personal electrical-field career strategy	1	2	3	4	5
	27. demonstrate cooperative interpersonal working characteristics	1	2	3	4	5
	34. update personal electrical-field career strategy	1	2	3	4	5
Technical Knowledge Proficiency	3. define basic electrical terms	1	2	3	4	5
	4. outline safe electrical working principles	1	2	3	4	5
	5. identify electrical conduit and raceway types	1	2	3	4	5
	11. analyze electrical trade catalogs	1	2	3	4	5
	12. interpret National Electrical Code requirements	1	2	3	4	5
	13. interpret electrical symbols	1	2	3	4	5
	23. complete computer-based (NEC) research assignments	1	2	3	4	5
	24. develop computer-based branch circuit wiring designs	1	2	3	4	5
Technical Skills Proficiency	9. outline basic wiring system installation procedures	1	2	3	4	5
	10. explain electrical system modernizing techniques	1	2	3	4	5
	14. identify common electrical housing box requirements	1	2	3	4	5
	15. determine common household electrical service requirements	1	2	3	4	5
	17. calculate electrical project material and labor costs	1	2	3	4	5
Foundation Skills Proficiency	16. solve electrical mathematics problems	1	2	3	4	5
	17. calculate electrical project material and labor costs	1	2	3	4	5
	25. demonstrate effective reading and writing skills	1	2	3	4	5
	26. exhibit effective listening skills	1	2	3	4	5

ACT and SCANS Competencies: ELE105, Introduction to Electrical Technology	
ACT	
1. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools such as hacksaws, pipe threaders, and conduit benders. 2. Works and coordinates with others (including people practicing other crafts) to complete assigned projects. 3. Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of a foreman. 4. Provides prompt and efficient service to customers by responding quickly to customer work orders. 5. Connects wiring to accessories, such as relays, circuit breakers, plugs, condensers, switches, and solenoids; and installs accessory assemblies in electrical or electronic units using soldering gun and hand tools. 6. Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools. 7. Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as grounding line equipment and jumpers. 8. Connects conductors to switches, receptacles, or appliances with proper methods of splicing or soldering and taping. 9. Connects wiring to lighting fixtures and power equipment using hand tools. 10. Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.	11. Lays the various outlets, switches, receptacles, and other details of the job from blueprints or by direction of the superintendent of construction. 12. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. 14. Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wire together, and applying tape or terminal caps or necessary lugs. 16. Reads and understands construction standards manual and is familiar with electrical codes. 17. Uses measuring instruments such as volt meters, ohm meters, and amp meters. 18. Interprets maintenance manuals, schematics, and wiring diagrams, and repairs equipment, utilizing knowledge of electronics and using standard test instruments using hand tools and power tools. 19. Reads work order to determine installation procedures specified by supervisor/technician. 20. Studies and understands electrical theory (Ohm's law; single-phase and three-phase circuits; and vectors, voltage drops, series and parallel circuits). 21. Tests circuits and electric components to locate grounded wires, broken connections, or detective current-control mechanisms using electrical testing instruments. 23. Attends regular safety meetings and reads distributed material regarding new safety procedures. 24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets. 25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork. 27. Suggests improvements in work methods by reviewing current procedures and using on-the-job experience to make tasks more efficient.

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28. Troubleshoots, repairs, and maintains, in accordance with diagrams, sketches, operation manuals, and manufacturer's specifications, machinery and equipment, such as transformers, tools, regulators, reclosers, capacitors, switches, fuses, and cut-outs. **31.** Recognizes and identifies the wide variety of conductors, such as underground and overhead. **32.** Assesses work environment for proper wiring methods and materials and hazardous locations. **37.** Locates cable and faults using fault and/or cable locating equipment. **41.** Works on energized lines with rubber gloves, mats, and blankets and/or live line tools.	**SCANS** **Managing Resources:** Manage time. Manage money. Manage materials. **Exhibiting Interpersonal Skills:** Work on teams. Lead work teams. Negotiate with others. Work with different cultures. **Working with Information:** Acquire/evaluate data. Organiz/maintain information. Process information with computers. **Applying Systems Knowledge:** Work within technological systems. Work within organizational systems. Design/improve systems. **Using Technology:** Select equipment & tools. Apply technology to specific tasks. Maintain/troubleshoot technologies. **Demonstrating Basic Skills:** Reading. Writing. Arithmetic and Mathematics. Listening. **Demonstrating Thinking Skills:** Creative thinking. Decision making. **Exhibiting Personal Qualities:** Individual responsibility

COMPETENCY PROFILE: ELE 115							
Category	**Content Goals**	**Proficiency Rating** Poor Average Superior					
Personal and Interpersonal Skill Proficiency	3. demonstrate cooperative interpersonal working characteristics	1	2	3	4	5
Technical Knowledge Proficiency	4. describe transistor functional principles	1	2	3	4	5
	5. compare electron tube and transistor characteristics	1	2	3	4	5
	6. describe various rectifier designs	1	2	3	4	5
	7. identify automatic control system functional principles	1	2	3	4	5
	8. determine rectifier requirements	1	2	3	4	5
	9. outline direct current requirements	1	2	3	4	5
	10. outline low voltage control system general characteristics	1	2	3	4	5
	11. compare galvanic anode and impressed current anode systems	1	2	3	4	5
	12. interpret resistor color band values	1	2	3	4	5
	13. identify fire alarm system characteristics	1	2	3	4	5
	14. describe heat detector operational principles	1	2	3	4	5
	15. describe corrosion fundamentals	1	2	3	4	5
	16. outline electromagnetic corrosion control methods	1	2	3	4	5
	17. identify battery bank connection methods	1	2	3	4	5
	20. interpret National Electrical Code requirements	1	2	3	4	5
	24. select electrical tools and equipment	1	2	3	4	5
	25. outline safe electrical working principles	1	2	3	4	5
Technical Skills Proficiency	2. demonstrate safe working habits	1	2	3	4	5
	18. create corrosion control system designs	1	2	3	4	5
	19. create wiring, schematic, and cable diagrams	1	2	3	4	5
	26. operate electrical measuring equipment	1	2	3	4	5
	27. construct test boards	1	2	3	4	5
	28. test resistors	1	2	3	4	5
	29. assemble common low-voltage electrical components	1	2	3	4	5
	30. perform lab assignments and projects	1	2	3	4	5
	31. verify electrical standard compliance	1	2	3	4	5
Foundation Skills Proficiency	1. demonstrate effective reading and writing skills	1	2	3	4	5
	21. solve electrical mathematics problems	1	2	3	4	5

ACT and SCANS Competencies:
ELE115, Low Voltage Circuits

ACT

2. Works and coordinates with others (including people practicing other crafts) to complete assigned projects.
3. Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of a foreman.
4. Provides prompt and efficient service to customers by responding quickly to customer work orders.
6. Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools.
7. Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as grounding line equipment and jumpers.
8. Connects conductors to switches, receptacles, or appliances with proper methods of splicing or soldering and taping.
9. Connects wiring to lighting fixtures and power equipment using hand tools.
10. Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.
12. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes.
14. Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wire together, and applying tape or terminal caps or necessary lugs.
15. Uses measuring instruments, such a as rulers, plumb-bobs, levels, and wire gauges.
16. Reads and understands construction standards manual and is familiar with electrical codes.
17. Uses measuring instruments such as volt meters, ohm meters, and amp meters.
19. Reads work order to determine installation procedures specified by supervisor/technician.
20. Studies and understands electrical theory (Ohm's law; single-phase and three-phase circuits; and vectors, voltage drops, series and parallel circuits).
21. Tests circuits and electric components to locate grounded wires, broken connections, or detective current-control mechanisms using electrical testing instruments.
23. Attends regular safety meetings and reads distributed material regarding new safety procedures.
24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets.
25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork.
26. Prepares sketches or as-built drawings showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring.
27. Suggests improvements in work methods by reviewing current procedures and using on-the-job experience to make tasks more efficient.
29. Takes measurements, such as street and building dimensions, distances to be spanned by wire and cable, or space available in existing buildings and underground vaults, which affect installation and arrangement of equipment.
37. Locates cable and faults using fault and/or cable locating equipment.
38. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.
40. Replaces defective components and parts, such as transistors, coils, and integrated circuits, using soldering iron, wire cutters, hand tools, and power tools.
41. Works on energized lines with rubber gloves, mats, and blankets and/or live line tools.

SCANS

Exhibiting Interpersonal Skills: Work on teams. Lead work teams. Negotiate with others. Work with different cultures.

Working with Information: Acquire/evaluate data.

Applying Systems Knowledge: Work within technological systems. Monitor/correct system performance. Design/improve systems.

Using Technology: Select equipment & tools. Apply technology to specific tasks. Maintain/troubleshoot technologies.

Demonstrating Thinking Skills: Creative thinking. Decision making.

COMPETENCY PROFILE: ELE 116		
Category	**Content Goals**	**Proficiency Rating** Poor Average Superior
Personal and Interpersonal Skill Proficiency	4. demonstrate cooperative interpersonal working characteristics	1 2 3 4 5
	27. update personal electrical-field career strategy	1 2 3 4 5
Technical Knowledge Proficiency	5. define basic electrical terms	1 2 3 4 5
	6. explain safe on-site electrical working requirements	1 2 3 4 5
	7. interpret National Electrical Code requirements	1 2 3 4 5
	10. identify various circuit and switch wiring principles	1 2 3 4 5
	11. develop computer-based circuits	1 2 3 4 5
	12. trace computer-based circuit pathways	1 2 3 4 5
	14. explain basic electrical component installation procedures	1 2 3 4 5
	16. interpret electrical drawings	1 2 3 4 5
Technical Skills Proficiency	3. exhibit safe working habits	1 2 3 4 5
	8. differentiate common electrical components	1 2 3 4 5
	9. specify electrical conductor requirements	1 2 3 4 5
	13. identify common electrical tool and material requirements	1 2 3 4 5
	17. determine common dwelling electrical service requirements	1 2 3 4 5
	20. use common electrical test equipment	1 2 3 4 5
	21. install branch circuits	1 2 3 4 5
	22. install basic feeder circuits	1 2 3 4 5
	23. perform lab assignments and projects	1 2 3 4 5
	24. install residential electrical system components	1 2 3 4 5
	25. build electrical service mockup	1 2 3 4 5
	26. verify electrical standard compliance	1 2 3 4 5
Foundation Skills Proficiency	2. apply effective communication skills	1 2 3 4 5
	15. solve electrical mathematics problems	1 2 3 4 5

ACT and SCANS Competencies:
ELE116, General Electrical Wiring

ACT

Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools such as hacksaws, pipe threaders, and conduit benders.

Works and coordinates with others (including people practicing other crafts) to complete assigned projects.

3. Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of a foreman.

4. Provides prompt and efficient service to customers by responding quickly to customer work orders.

Connects wiring to accessories, such as relays, circuit breakers, plugs, condensers, switches, and solenoids; and installs accessory assemblies in electrical or electronic units using soldering gun and hand tools.

Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools.

Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as grounding line equipment and jumpers.

Connects conductors to switches, receptacles, or appliances with proper methods of splicing or soldering and taping.

9. Connects wiring to lighting fixtures and power equipment using hand tools.

Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.

Lays the various outlets, switches, receptacles, and other details of the job from blueprints or by direction of the superintendent of construction.

Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes.

Plans, lays out, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment using hand tools and power tools.

Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wire together, and applying tape or terminal caps or necessary lugs.

Reads and understands construction standards manual and is familiar with electrical codes.

17. Uses measuring instruments such as volt meters, ohm meters, and amp meters.

Interprets maintenance manuals, schematics, and wiring diagrams, and repairs equipment, utilizing knowledge of electronics and using standard test instruments using hand tools and power tools.

20. Studies and understands electrical theory (Ohm's law; single-phase and three-phase circuits; and vectors, voltage drops, series and parallel circuits).

21. Tests circuits and electric components to locate grounded wires, broken connections, or detective current-control mechanisms using electrical testing instruments.

22. Installs and connects single-phase and three-phase bank transformer connections and capacitor banks/voltage regulators.

23. Attends regular safety meetings and reads distributed material regarding new safety procedures.

24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets.

25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork.

26. Prepares sketches or as-built drawings showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring.

27. Suggests improvements in work methods by reviewing current procedures and using on-the-job experience to make tasks more efficient.

30. Operate radio to communicate with co-workers and dispatchers.

31. Recognizes and identifies the wide variety of conductors, such as underground and overhead.

32. Assesses work environment for proper wiring methods and materials and hazardous locations.

35. Installs and replaces duct systems and underground cable (works in underground vaults where cables are located).

36. Installs, maintains, and repairs pedestals, equipment pads, switching cabinets, pad-mounted transformers, and other underground equipment.

37. Locates cable and faults using fault and/or cable locating equipment.

38. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.

39. Removes obstructions (steel structures, manhole covers, substation enclosures) and material in order to gain access to and remove defective parts or perform maintenance, using hoists, personnel lifts, cranes, hand tools and power tools.

40. Replaces defective components and parts, such as transistors, coils, and integrated circuits, using soldering iron, wire cutters, hand tools, and power tools.

41. Works on energized lines with rubber gloves, mats, and blankets and/or live line tools.

42. Terminates, splices, and tests cable according to manufacturing specifications.

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SCANS	
Exhibiting Interpersonal Skills: Work on teams. Lead work teams. Negotiate with others. Work with different cultures. **Exhibiting Interpersonal Skills:** Work on teams. Serve customers. Lead work teams. Negotiate with others. **Working with Information:** Acquire/evaluate data. Interpret and communicate data. Process information with computers. **Applying Systems Knowledge:** Work within technological systems. Design/improve systems. **Using Technology:** Select equipment & tools. Apply technology to specific tasks. Maintain/troubleshoot technologies. **Demonstrating Basic Skills:** Reading. Writing. Arithmetic and mathematics. Speaking. Listening. **Demonstrating Thinking Skills:** Decision making. Problem solving. Seeing with the mind's eye. **Exhibiting Personal Qualities:** Individual responsibility.	

COMPETENCY PROFILE: ELE 206		
Category	**Content Goals**	**Proficiency Rating** Poor Average Superior
Resource Management Proficiency	39. determine commercial project completion timelines	1 2 3 4 5
	40. develop commercial project cost analysis	1 2 3 4 5
Technical Knowledge Proficiency	3. recall safe electrical working principles	1 2 3 4 5
	4. recall National Electrical Code requirements	1 2 3 4 5
	5. recall electrical blueprint symbols	1 2 3 4 5
	6. interpret commercial building plan specifications	1 2 3 4 5
	7. interpret commercial building plan specifications	1 2 3 4 5
	9. recall electrical system modernizing techniques	1 2 3 4 5
	10. verify common electrical switch, receptacle, and application rating compatibility	1 2 3 4 5
	11. describe miscellaneous owner-controlled circuit and switch installation requirements	1 2 3 4 5
	15. calculate electrical load and branch circuit requirements	1 2 3 4 5
	16. perform conductor withstand rating calculations	1 2 3 4 5
	17. make short-circuit calculations	1 2 3 4 5
	20. describe cooling system components and functions	1 2 3 4 5
	21. calculate cooling system requirements	1 2 3 4 5
	26. select emergency power systems	1 2 3 4 5
	28. recall automatic control system functional principles	1 2 3 4 5
	34. explain major appliance wiring installation methodologies	1 2 3 4 5
	35. prescribe appliance branch-circuit wiring and grounding specifications	1 2 3 4 5
Technical Skills Proficiency	12. perform panel board modifications	1 2 3 4 5
	18. assemble branch-circuit installation materials	1 2 3 4 5
	23. perform low-voltage remote-control installations	1 2 3 4 5
	27. install emergency power systems	1 2 3 4 5
	32. perform special system conduit and circuit installations	1 2 3 4 5
	33. install transformer and grounding systems	1 2 3 4 5
	36. plan electrical conduit and component layouts	1 2 3 4 5
	37. select branch-circuit installation materials	1 2 3 4 5
Foundation Skills Proficiency	2. apply effective reading, writing, speaking, and listening skills	1 2 3 4 5
	14. demonstrate general mathematics skills	1 2 3 4 5
	24. determine fuse and circuit breaker overcurrent protection requirements	1 2 3 4 5
	42. validate personal electrical-field career plan	1 2 3 4 5

ACT and SCANS Competencies:
ELE206, Commercial Planning

ACT

Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools such as hacksaws, pipe threaders, and conduit benders.

Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of a foreman.

5. Connects wiring to accessories, such as relays, circuit breakers, plugs, condensers, switches, and solenoids; and installs accessory assemblies in electrical or electronic units using soldering gun and hand tools.

Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools.

7. Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as grounding line equipment and jumpers.

8. Connects conductors to switches, receptacles, or appliances with proper methods of splicing or soldering and taping.

Connects wiring to lighting fixtures and power equipment using hand tools.

10. Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.

Lays the various outlets, switches, receptacles, and other details of the job from blueprints or by direction of the superintendent of construction.

12. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes.

Plans, lays out, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment using hand tools and power tools.

14. Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wire together, and applying tape or terminal caps or necessary lugs.

16. Reads and understands construction standards manual and is familiar with electrical codes.

Interprets maintenance manuals, schematics, and wiring diagrams, and repairs equipment, utilizing knowledge of electronics and using standard test instruments using hand tools and power tools.

9. Reads work order to determine installation procedures specified by supervisor/technician.

Tests circuits and electric components to locate grounded wires, broken connections, or detective current-control mechanisms using electrical testing instruments.

Installs and connects single-phase and three-phase bank transformer connections and capacitor banks/voltage regulators.

3. Attends regular safety meetings and reads distributed material regarding new safety procedures.

24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets.

25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork.

26. Prepares sketches or as-built drawings showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring.

30. Operate radio to communicate with co-workers and dispatchers.

31. Recognizes and identifies the wide variety of conductors, such as underground and overhead.

32. Assesses work environment for proper wiring methods and materials and hazardous locations.

33. Digs trench and lays underground cable and conduit to connect source of power to customer's building, setup outdoor lighting as well as laying underground cable and conduit for data and communications (commercial, industrial, and residential).

36. Installs, maintains, and repairs pedestals, equipment pads, switching cabinets, pad-mounted transformers, and other underground equipment.

38. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.

39. Removes obstructions (steel structures, manhole covers, substation enclosures) and material in order to gain access to and remove defective parts or perform maintenance, using hoists, personnel lifts, cranes, hand tools and power tools.

40. Replaces defective components and parts, such as transistors, coils, and integrated circuits, using soldering iron, wire cutters, hand tools, and power tools.

41. Works on energized lines with rubber gloves, mats, and blankets and/or live line tools.

42. Terminates, splices, and tests cable according to manufacturing specifications.

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SCANS	
Managing Resources: Manage time. Manage money. **Exhibiting Interpersonal Skills:** Serve customers. Negotiate with others. **Work with Information:** Acquire/evaluate data. Organize/maintain information. **Applying Systems Knowledge:** Work within technological systems. Work within organizational systems. Design/improve systems. **Using Technology:** Select equipment & tools. Apply technology to specific tasks. **Demonstrating Basic Skills:** Reading. Writing. Arithmetic and mathematics. Speaking. Listening. **Demonstrating Thinking Skills:** Decision making. Problem solving. Seeing with the mind's eye. **Exhibiting Personal Qualities:** Individual responsibility	

Product D:

Fact Sheets

THE NATIONAL

SCAN SKILLS *Concern*

GET THE FACTS

"What we found was disturbing: more than half our young people leave school without the knowledge or foundation required to find and hold a good job."
--What Work Requires Of Schools
A SCANS Report For America 2000

In 1990 the United States Secretary of Labor appointed a group called the Secretary's Commission on Achieving Necessary Skills (SCANS) to determine the skills people need to succeed in the world of work. The Commission was composed of 30 representatives of education, business, labor, and state government and was "charged with defining a common core of skills that constitute job readiness in the current economic environment." An environment facing fierce economic competition, new technologies, and rapidly changing skill requirements. Specifically, the Commission was asked to:

- Define the skills needed for employment;
- Propose acceptable levels of proficiency;
- Suggest effective ways to assess proficiency; and
- Develop a dissemination strategy for the nation's schools, businesses, and homes.

During the course of its work, SCANS produced several publications. The Commission's first report, *What Work Requires of Schools*, resulted from extensive meetings and discussions with a variety of organizations including business, industry, public employers, and unions. The report identifies 36 workplace skills "that high-performance workplaces require and that high-performance schools should produce." These skills are divided into a Three-Part Foundation and Five Competencies. The Three-Part Foundation includes **basic skills** which include literacy and computational skills, **thinking skills** described as necessary to put knowledge to work, and **personal qualities** described as making workers dedicated and trustworthy. The Five Competencies include the ability to manage **resources**, **interpersonal** skills needed to work amicably and productively with others, the ability to acquire and use **information**, skills needed to master complex **systems**, and skills needed to work with **technology**.

It was the finding of the Commission that these skills "lie at the heart of job performance and are essential preparation for all students, both those going directly to work and those planning further education." The Commission believes the most effective way of learning skills is "in context" teaching learning objectives within a real environment and that the SCANS foundation and competencies be taught and understood in an integrated fashion that reflects the workplace contexts in which they are applied.

Turn this page for a complete listing of the SCANS Three-Part Foundation and Five Competencies.

Source: *What Work Requires of Schools, A SCANS Report for America 2000*, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210.

UNITED STATES DEPARTMENT OF LABOR
SECRETARY'S COMMISSION ON ACHIEVING NECESSARY SKILLS

THREE-PART FOUNDATION

Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks

A. *Reading* - locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules

B. *Writing* - communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts

C. *Arithmetic/Mathematics* - performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques

D. *Listening* - receives, attends to, interprets, and responds to verbal messages and other cues

E. *Speaking* - organizes ideas and communicates orally

Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons

A. *Creative Thinking* - generates new ideas

B. *Decision Making* - specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative

C. *Problem Solving* - recognizes problems and devises and implements plan of action

D. *Seeing Things in the Mind's Eye* - organizes and processes symbols, pictures, graphs, objects, and other information

E. *Knowing How to Learn* - uses efficient learning techniques to acquire and apply new knowledge and skills

F. *Reasoning* - discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem

Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, integrity and honesty

A. *Responsibility* - exerts a high level of effort and perseveres towards goal attainment

B. *Self Esteem* - believes in own self-worth and maintains a positive view of self

C. *Sociability* - demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings

D. *Self Management* - assesses self accurately, sets personal goals, monitors progress, and exhibits self-control

E. *Integrity/Honesty* - chooses ethical courses of action

UNITED STATES DEPARTMENT OF LABOR
SECRETARY'S COMMISSION ON ACHIEVING NECESSARY SKILLS

FIVE COMPETENCIES

Resources: Identifies, organizes, plans, and allocates resources

A. *Time* - selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules

B. *Money* - uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives

C. *Materials and Facilities* - acquires, stores, allocates, and uses materials or space efficiently

D. *Human Resources* - assesses skills and distributes work accordingly, evaluates performance and provides feedback

Interpersonal: Works with others

A. *Participates as a Member of a Team* - contributes to group effort

B. *Teaches Others New Skills*

C. *Serves Clients/Customers* - works to satisfy customer's expectations

D. *Exercises Leadership* - communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies

E. *Negotiates* - works toward agreements involving exchange of resources, resolves divergent interests

F. *Works with Diversity* - works well with men and women from diverse backgrounds

Information: Acquires and uses information

A. *Acquires and Evaluates Information*

B. *Organizes and Maintains Information*

C. *Interprets and Communicates Information*

D. *Uses Computers to Process Information*

Systems: Understands complex inter-relationships

A. *Understands Systems* - knows how social, organizational, and technological systems work and operates effectively with them

B. *Monitors and Corrects Performance* - distinguishes trends, predicts impacts on system operations, diagnoses systems' performance and corrects malfunctions

C. *Improves or Designs Systems* - suggests modifications to existing systems and develops new or alternative systems to improve performance

Technology: Works with a variety of technologies

A. *Selects Technology* - chooses procedures, tools or equipment including computers and related technologies

B. *Applies Technology to Tasks* - understands overall intent and proper procedures for setup and operation of equipment

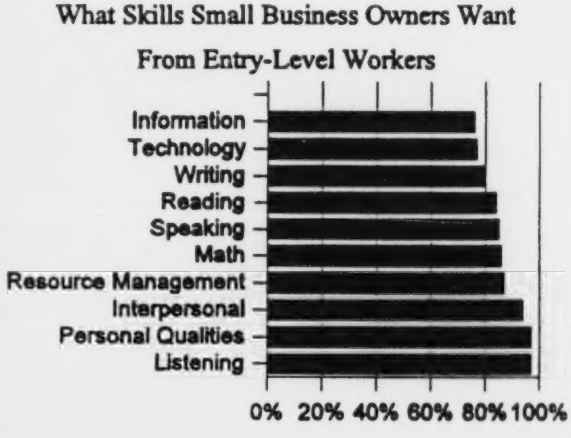
C. *Maintains and Troubleshoots Equipment* - prevents, identifies, or solves problems with equipment, including computers and other technologies

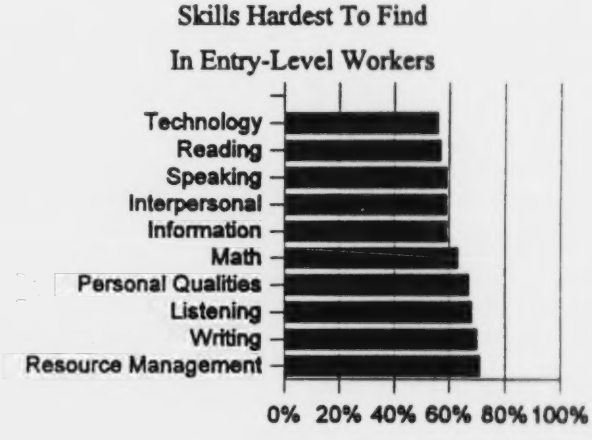
Source: *What Work Requires of Schools, A SCANS Report for America 2000*, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington , D.C. 20210.

A LOCAL

SCAN SKILLS *Survey*

Several of the skills identified by the United States Secretary's Commission on Achieving Necessary Skills (SCANS) as being needed to succeed in the world of work were validated locally. On June 23, 1994, The Dallas Morning News captured the essence of the national movement toward linkage of national skill standards and workplace skill needs in a special report. Based on a survey of 5,000 Dallas-Fort Worth area companies, they reported that small business owners (500 or fewer employees) wanted, but were unable to find entry-level job applicants with the following ten basic skills: listening, personal qualities, interpersonal, resource management, math, speaking, reading, writing, technology, and information. The survey, which was conducted by the National Alliance of Business, asked respondents to rate the importance of these skills and indicate how hard they are to find in entry-level applicants. Results are graphically depicted below.





The article states that of the 673 respondents, 52 percent said they were manufacturing companies, 44 percent were service companies and 4 percent said they were in other types of business. More than half of the respondents indicated they "sometimes" or "usually" have trouble finding applicants with these skills. The results of this study are similar to the alliance's findings from previous surveys in Los Angeles and Miami. They also are similar to a 1990 survey of the nation's 1,200 largest public and private corporations. Almost two-thirds of the corporations said they were dissatisfied with the competency of job applicants, and 84 percent said new employees weren't sufficiently educated.

Source: Files, Jennifer. "Qualified Workers for Entry-Level Jobs Difficult To Find." The Dallas Morning News 23 June 1994: 1D.

This fact sheet was published by the North Lake College Skill Standards and Certification Project 6/95.

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A NORTH LAKE STRATEGY FOR

Infusing SCAN SKILLS

GET THE FACTS

In 1994 the Tri-Agency partnership of the Texas Education Agency (TEA), Texas Department of Commerce (TDOC), and Texas Higher Education Coordinating Board (THEB), conducted a Skills Development Program. Under this program North Lake College was awarded a grant to participate in a **Skill Standards and Certification Project** to develop a method to identify and integrate industry-validated workplace and technical skills into vocational technical curricula. An ancillary objective of the project was to apply national occupational standards to the development of technical and occupational programs. Richland College, Texas State Technical College - Marshall, and Texas Instruments with the University of North Texas were also awarded grants.

For the purpose of the pilot of this project the demand occupation of Electrical Worker was selected by North Lake College. However, the process can be applied to any occupational area.

North Lake partnered with the Dallas Electrical Joint Apprenticeship and Training Committee (DJATC) to accomplish project objectives, activities, and products.

During this project seven of the SCANS workplace skill areas were targeted for curriculum applications: Reading for Information, Writing, Applied Mathematics, Listening, Teamwork, Locating Information, and Applied Technology.

The American College Testing Program (ACT) was the occupational profiling contractor for the project. Through their *Work Keys* process which utilizes subject matter experts, they provided an electrician job profile which involved the following three steps: (1) Developing a list of the most critical tasks to the occupation; (2) Identifying on-the-job behaviors associated with each skill as it is used in the occupation; and (3) Determining the skill levels of the occupation.

Texas A & M's Public Policy Research Institute performed project evaluation activities. They reported project results, conducted process and outcome evaluations, and provided public policy recommendations to the State.

As a result of this project, a model for infusing workplace skills into academic and occupational programs at the secondary, post-secondary, and apprenticeship levels was developed. It includes a four-phase process: occupational profiling, curriculum enhancement, faculty development, and testing and certification.

The North Lake College Skill Standards and Certification Project model appears on the following page.

An executive summary describing the steps in the model is available through North Lake College administration.

North Lake College
Skill Standards and Certification Project

Work Keys OCCUPATIONAL PROFILING	CURRICULUM ENHANCEMENT	FACULTY DEVELOPMENT	TESTING AND CERTIFICATION
-Conduct occupational research -Define workplace skills -Conduct job observations -Contact/secure local subject matter experts -Conduct profile session -Develop list of most critical tasks performed at entry-level -Select workplace skills to be infused into existing curricula -Identify on-the-job behaviors associated with each skill -Determine level of workplace skill required to perform each job task -Develop profile document summarizing results	-Establish curriculum enhancement team -Conduct sampling course observations -Study course syllabi and objectives -Review instructional materials & methods -Gather & review research materials -Employ faculty content experts -Select curriculum analysis method -Study job profile -Analyze curriculum -Select enhancement strategy -Identify enhancements -Implement select enhancements -Implement computer-based enhancements -Revise course syllabi -Conduct National Electrical Construction job/duties analysis -Conduct evaluation	-Conduct literature review -Conduct interviews -Develop faculty learning objectives -Select learning activities/modes -Determine instructional support factors -Determine evaluation methods -Develop E-Mail newsletter -Develop fact sheets -Develop CBE and SCANS workshop -Develop mentoring plan -Provide video tape training -Provide technical assistance and consultation	-Research assessment strategies -Analyze current assessments -Identify assessment strategies -Conduct pre- and post tests -Develop competency profile -Conduct computer-based testing

Trained Workforce

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A NORTH LAKE STRATEGY continued...

One of the activities of this project included selecting faculty experts from the North Lake College faculty who teach teamwork, speech, reading, writing, mathematics, and electrical technology. These faculty were asked to pair the competencies of the (SCANS) workplace skills with associated learning activities that facilitate the development of these skills. Their reports successfully provided a selection of learning activities that can be infused into the existing curriculum to promote mastery of the skill areas. A sample of learning activities for **Reading for Information** appears below.

Locate, understand and interpret written information in prose and documents including manuals, graphs and schedules to perform tasks. (Basic comprehension skills of written material)

- Read an employee handbook to learn about safety policies. Develop questions specific to safety policies.
- Read a basic job function and list in sequence the steps to accomplish the task.
- Read printed material about the job and rewrite the job description in the reader's words.
- Read material about the function of a particular tool and answer main idea and detail questions about the material.
- Develop activities that question differences and similarities with procedures or tools.
- Using charts and forms, develop activities that address the main idea of the text of the chart and forms.
- Read product information to make a buying decision.
- Using work-related forms, develop activities that question the message of the form. What is it really communicating to the reader?
- Using job situations, develop role play situations for small groups to read, process and discuss. (Job Cards-Group Dynamics.)
- Choose specific sections from required readings from manuals and develop multiple choice questions over the material.

Learn from text by determining the main idea or essential message. (Interpret written information)

- Present work orders and prompt the reader to interpret a work order. Be specific with the directions. (i.e., For the task you will interpret the codes on the display above. You will use the Electrician's Code manual to translate these codes onto the final work order.)
- Create activities that use text and visual materials together for the reader to interpret.
- Create activities that address and utilize flowchart sequences, codes and symbols, and their relationships with the individual job tasks.

- Select a variety of texts from technical materials and develop activities that will give the reader an opportunity to interpret the material in his own words. (Can he give the material back to you in his own words? This is a clear indication of his comprehension level of reading.)

- Use job specific material. Choose paragraphs and ask the reader to identify the main idea of each individual paragraph. (i.e., Electrical theory, circuits, voltage drops, etc.)

Identify relevant details, facts and specifications. (Locate written information)

- Develop activities that will help the reader become familiar with parts of a book or manual. (Table of contents, index, glossary, etc.)

- Develop activities that include reading specific materials to determine outcomes:
  Truck inspection form-details to be checked off
  Time sheets-which employee works at particular times
  Accident report-when, who, where and what happened?
  Work orders-sequence of job to be accomplished
  Oil spill sheet-records of spill

Infer or locate the meanings of unknown or technical vocabulary.

- Develop a technical vocabulary list for each text.

- Create activities to teach and enhance the usage of the technical vocabulary to become a part of the reader. "Claim ownership of this vocabulary."

- To understand specialized words or phrases in an unfamiliar context, develop paragraphs where these words are used in their functional context.

- Create vocabulary cells or packets in short "doses." Be sure to use the words in context of the job task. Develop activities that not only require the reader to fill in the blank with the correct words, but also will challenge his reading skills.

- Develop jargon word banks for each course of study. The reader will add to the bank as he masters the word with short and long term memory.

- Ask the reader to use the words in his own sentences in many different types of settings. (i.e., Small groups, on paper, role-playing, etc.)

Judge the accuracy, appropriateness, style, and plausibility of reports, proposals, or theories of other writers.

- Develop sample reports and instruct the reader to judge the accuracy and appropriateness of the written material.

The above learning activities were submitted by Jan Franke, Communications Division, North Lake College
This fact sheet was published by the North Lake College Skill Standards and Certification Project 6/95.

Product E:

E-Mail Newsletter

SCANS UPDATE

Vol.1 Issue 1 May, 1995

Introduction

The electronic faculty development newsletter, **"Scans Update"** is intended to bring you information to improve your teaching skills. The newsletter is a product of the **North Lake Skills Standards and Certification Project** designed to teach community college faculty how to infuse workplace skills directly into the teaching of any occupational/technical programs. The Secretary's Commission on Achieving Necessary Skills, US Department of Labor, has identified writing as one basic skill that is required in today's workplace. This newsletter suggests twelve ways writing can be incorporated into teaching electrical technology and pairs those with the six competencies that **SCANS** identifies for writing. The competencies are in capital letters and the associated learning activity supporting the achievement of the competency is listed below it.

COMMUNICATING THOUGHTS, IDEAS, INFORMATION, AND MESSAGES IN WRITING

#1, Students may be required to write memos to "supervisors" detailing proposed solutions to problems supplied by the instructor, relating to safety or the National Electrical Code.

#2, Students may be required to read sections of the NEC or textbooks and to write a summary of the key points.

RECORD INFORMATION ACCURATELY AND COMPLETELY

#3, Students may be required to **write** an accident report, detailing conditions, description of events, and overall evaluation of an accident either real or staged.

#4, Students should be required to take data from a wiring diagram on a blueprint and complete a branch circuit schedule.

COMPOSE AND CREATE DOCUMENTS SUCH AS LETTERS, DIRECTIONS, MANUALS, REPORTS, PROPOSALS, GRAPHS, AND FLOW CHARTS

#5, Students may be required to prepare proposals for an electrical installation based on blueprints and specifications provided by the instructor.

#6, Students may be required to prepare flow charts detailing a process such as designing a motor control system, designing the wiring system for a residence or business and troubleshooting systems.

USE LANGUAGE, STYLE, ORGANIZATION, AND FORMAT APPROPRIATE TO THE SUBJECT MATTER, PURPOSE, AND AUDIENCE.

#7, Students may be required to write their own resume' based on form and format information provided by the instructor and compatible with current employment practices.

#8, Students may be required to write letters or memos to a variety of audiences for different purposes. For example, some may be written to customers requesting payment on overdue accounts, some may be written to potential customers soliciting their business, some any be written to government agencies soliciting information on licensing and permitting practices in that municipality or state, or some may be written as memos for "in house" information to other employees or management.

INCLUDE SUPPORTING DOCUMENTATION AND ATTEND TO LEVEL OF DETAIL

#9, Students may be required to submit all drafts and reports or research papers with the expectation that evidence of revision and/or editing would appear on first and second drafts.

#10, Students may be required to document answers on essay questions concerning the NEC, by quoting the exact article and section of the code which governs the response.

CHECK, EDIT, AND REVISE FOR CORRECT INFORMATION, APPROPRIATE EMPHASIS, FORM, GRAMMAR, SPELLING, AND PUNCTUATION

#11, Students may be required to submit all drafts and reports or research papers with the expectation that evidence of revision and/or editing would appear on first and second drafts.

#12, Students should be required to use standard English grammar and correct spelling on all essay answers in examination, lab reports, and essays.

As you introduce these learning strategies to develop writing skills in the Electrical Technology Program at North Lake College consider the words of Lee Odell who states, "Instructors in vocational/technical courses should consider using writing (as opposed to teaching writing) as a means of helping students think about and come to their own understanding of the subject matter of particular courses." ("On Using Writing" from "Writing Across the Curriculum in Community Colleges" New Directions for Community Colleges. Jossey-Bass Inc., Publishers, #73, Spring, 1991.)

If you need further information please contact Larry Blevins, NLC Electrical Technology Program Coordinator and/or Joe Bishop, NLC Writing faculty, who collaborated in developing these strategies.

Product F:

Competency-Based Education and SCANS Workshop Plan

CBE

and

SCANS

Professional Development Workshop

CBE and SCANS
Professional Development Workshop Plan

Developed by:
The North Lake College Skill Standards and Certification Project

June, 1995

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INTRODUCTION

Professional development of the faculty and adjunct faculty at North Lake College is an on-going responsibility and commitment to the college's mission of providing quality instruction and educational programs to develop tomorrow's workforce.

One of the activities of the North Lake College Skill Standards and Certification project was to conduct a needs assessment and develop recommended strategies for a faculty development plan to apply national skill standards and infuse SCANS (workplace skills) into existing curricula. As a result of that Project, this workshop has been developed as a primary means to instruct faculty on **HOW TO DEVELOP AND APPLY COMPETENCY-BASED AND WORKPLACE SKILLS INFUSED CURRICULA.**

This workshop has been designed for North Lake College faculty who support the concept of competency-based education and workplace skills integration. Two workshop agendas have been developed. The first is presented in a one-day session. The second is divided into two evening sessions to accommodate adjunct faculty with full-time job commitments outside of their teaching responsibilities. In addition, a half-day follow-up session has been designed to assess faculty usage and provide technical assistance.

Upon completion of the workshop sessions, participants will be asked to serve as mentors to their faculty colleagues. Their comfort and success in developing and applying competency-based and workplace skills infused curricula is key in gaining greater faculty support and participation. A mentoring plan appears in the Resource section of this document.

A final report, an executive summary, and independent evaluation information concerning the North Lake College Skill Standards and Certification Project is available through North Lake College administration.

WORKSHOP OBJECTIVES

Upon completion of this workshop, participants will be able to:

* List technical and workplace competencies associated with entry-level skills of the occupation
* Complete a SCANS analysis
* Develop quality syllabi for courses
* Write performance objectives
* Develop learning activities
* Apply student assessments that are criterion-referenced
* Use student competency profiles

AGENDA

CBE and SCANS Workshop
(one-day session)

8:30 a.m. - 8:45 a.m.	Welcome, Overview, Introductions
8:45 a.m. - 9:00 a.m.	Review of Terminology
9:00 a.m. - 9:30 a.m.	Video: "Competency Based Education: Meeting the Educational Challenges of Today...and Tomorrow!"
9:30 a.m. -10:30 a.m.	How to list technical and workplace competencies associated with entry-level skills of the occupation
10:30 a.m.-10:45 a.m.	Break
10:45 a.m.-11:15 a.m.	How to complete a SCANS analysis
11:15 a.m.-11:45 a.m.	How to develop quality syllabi
11:45 a.m.-12:30 p.m.	Lunch
12:30 p.m.- 1:30 p.m.	How to write performance objectives
1:30 p.m. - 3:00 p.m.	How to develop learning activities
3:00 p.m. - 3:15 p.m.	Break
3:15 p.m. - 4:15 p.m.	How to apply student assessments that are criterion referenced
4:15 p.m. - 4:45 p.m.	How to use student competency profiles
4:45 p.m. - 5:00 p.m.	Review of resources, Mentoring Plan, Evaluation of workshop, Close

AGENDA

CBE and SCANS Workshop
(two evening sessions)

First Evening

6:00 p.m. - 6:15 p.m.	Welcome, Overview, Introductions
6:15 p.m. - 6:30 p.m.	Review of Terminology
6:30 p.m. - 7:00 p.m.	Video: "Competency Based Education: Meeting the Educational Challenges of Today...and Tomorrow!"
7:00 p.m. - 8:00 p.m.	How to list technical and workplace competencies associated with entry-level skills of the occupation
8:00 p.m. - 8:15 p.m.	Break
8:15 p.m. - 8:45 p.m.	How to complete a SCANS analysis
8:45 p.m. - 9:15 p.m.	How to develop quality syllabi
9:15 p.m. - 10:00 p.m.	How to write performance objectives

Second Evening

6:00 p.m. - 6:30 p.m.	Review
6:30 p.m. - 8:00 p.m.	How to develop learning activities
8:00 p.m. - 8:15 p.m.	Break
8:15 p.m. - 9:15 p.m.	How to apply student assessments that are criterion referenced
9:15 p.m. - 9:45 p.m.	How to use student competency profiles
9:45 p.m. - 10:00 p.m.	Review of resources, Mentoring Plan, Evaluation of workshop, Close

WORKSHOP OUTLINE AND ACTIVITIES

I. Welcome, Introductions, Overview:

Welcome participants.

Introduce facilitators and presenters.

Have participants introduce themselves.

Present overview of workshop including the purpose:

To learn how to develop and apply competency-based and workplace skills infused curricula.

Why?

* To help our students succeed in the workplace
* To be responsive to industry needs
* To build a stronger workforce that is able to compete in world markets
* To meet THECB mandates

Review workshop agenda

II. Review of Terminology:

Competence - Ability to perform a task to a predetermined standard

Competency - A learned behavior which can be repeated to a predetermined standard.

Competency-based education (CBE) - A methodology of instruction that (a) identifies the cognitive, psychomotor, and affective skills needed to meet a specified standard; (b) informs students and teachers of the precise and detailed learning objectives required to achieve performance; (c) emphasizes performance standards in testing, course requirements, and/or graduation; and (d) facilitates learning by allowing each student to master the task through flexibility in learning time and methods.

SCANS - Secretary's Commission on Achieving Necessary Skills

SCAN skills - The skills identified by the Commission as necessary for success in the workplace. (A complete listing of SCANS competencies and foundations appears in the Resource section of this document.)

Standard - Criteria which specify what constitutes successful completion of a prescribed performance.

Sources:

Competency-Based Education Professional Development Series, The Mid-America Vocational Curriculum Consortium, Inc., 1500 West Seventh Avenue, Stillwater, OK 74074-4364. 1992

What Work Requires of Schools, A SCANS Report for America 2000, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210

III. Video: "Competency Based Education: Meeting the Educational Challenges of Today...and Tomorrow!":

View the 21 minute video.

Major characteristics of competency-based program

* Course content is based on an occupational/program analysis
* Student performance objectives are specified in advance of instruction
* An instructional delivery system is used that allows for individualization, feedback, flexibility, and reteaching.
* A criterion-referenced evaluation system is used to measure a student's competency-level.

Principles of competency-based education
Note: These principles are based on Bloom's model for mastery learning

* Any student in a training program can perform most tasks at a high level of mastery if provided with quality instruction and sufficient time.
* A student's ability to learn a task need not predict how well the student learns the task.
* Individual student differences in levels of mastery of a task are more frequently caused by inadequacies in the learning environment rather than by characteristics of the student.
* Most students become very similar to one another in learning ability, rate of learning, and motivation for learning when provided with favorable learning conditions.
* Educators should focus more on differences in learning and less on differences in learners.

* The most important element in the teaching/learning process is the kind and quality of instruction experienced by the student.

Advantages of competency-based education

* Allows student to advance at his/her own pace within program guidelines
* Allows teacher to function as a manager and resource person
* Promotes action-oriented instruction
* Provides for more efficient use of facilities and equipment
* Gives student credit for prior knowledge
* Provides for greater accountability of the teacher and the student (Note: The student becomes more responsible for his/her learning. Objectives are identified at beginning of instruction.)
* Provides a skilled worker/learner upon completion of the course or program
* Facilitates site-based management
* Allows for programs to articulate based on identified objectives

IV. How to list technical and workplace competencies associated with entry-level skills of the occupation:

Order and include the CBE Professional Development Series unit "Aligning Curriculum" for use when teaching this objective.

Present relevant information in the green sheets beginning with terms and definitions. It is suggested in the series that this information be provided to participants prior to the workshop session.

Suggested activities, assignments, and a test are included in the unit.

Items of priority in the green sheets include:

Item #7 "Sources of Curriculum Materials." Provide names and addresses of relevant resources. At this time provide samples of information gathered from these resources (i.e., DACUM charts, job task analysis lists.)

Item #8 "Procedures for Completing a Task Analysis for a Program or Course." Present occupational analysis methods used and approved by the DCCCD (i.e. DACUM, job task analysis, and task validation.)

Item #9 "Reasons for Verifying a Task List." Cover the importance of validating information obtained from another source to make sure it reflects employer needs in our placement area.

Item #10 "Benefits of Involving Business, Industry, and Labor in Curriculum Development." Provide a list to add credibility to the process.

Item #11 "Techniques to Verify or Validate Task Lists." Briefly outline four methods.

Item #12 "Ways to Sequence Tasks." Offers suggestions.

Item #13 "Steps in Conducting an Instructional Analysis." Address how to *apply* a validated task list.

V. How to complete a SCANS analysis:

Describe how to complete a SCANS analysis of current curriculum.

Provide analysis worksheets and complete an analysis activity.

Address strategies and activities to infuse workplace skills into current curriculum.

VI. How to develop quality syllabi:

Present the essential elements listed on the "Components of a Quality Syllabus" which appears in the Resource section of this document.

Provide samples of quality syllabi to participants.

Discuss using the PEAKS CourseBuilder software as an option.

VII. How to write performance objectives:

Order and include the CBE Professional Development Series unit "Writing Performance Objectives" for use when teaching this objective.

Present relevant information in the green sheets beginning with terms and definitions. Most of the terms will have been covered previously. It is suggested in the series that this information be provided to participants prior to the workshop session.

Suggested activities, assignments, and tests are included in the unit.

Items of priority in the green sheets include:

Item #2 "Instructional Intent of a Performance Objective." Describe the purpose of this process.

Item #3 "Advantages of Using Performance Objectives." List ten advantages from, "makes course content clear" to, "provides accountability in instruction."

Item #4 "Things to Do Before Writing Performance Objective." List the items that have been presented earlier in this workshop.

Item #5 "Components of a Performance Objective." Describe conditions, behaviors, and standards.

Item #6 "Domains of the Taxonomy of Educational Objectives." Describe cognitive, psychomotor, and affective domains.

Item #7 "Criteria for Writing Performance Objectives." List criteria to remember when developing performance objectives.

Provide samples of performance objectives to participants that meet the above criteria.

Discuss using the PEAKS software as a tool.

VIII. How to develop learning activities:

Order and include the CBE Professional Development Series unit "Developing Teaching/Learning Strategies" for use when teaching this objective.

Present relevant information in the green sheets. It is suggested in the series that this information be provided to participants prior to the workshop session.

Suggested activities, assignments, and a test are included in the unit.

Items of priority in the green sheets include:

Item #2 "Teacher Characteristics that Support Quality Learning." Describe the responsibility of the teacher in making CBE a success.

Item #3 "Strategies for Meeting Individual Learning Styles." Note the overall goal of instruction is to meet individual learner needs and to provide for individual differences. List the ten strategies.

Item #5 "Guidelines to Consider in Selecting Strategies for Individualizing Instruction." List the guidelines.

Item #6 "Strategies for Motivating Student." Provide strategies and examples.

Item #8 "Techniques for Instructional Delivery." Provide techniques ranging from audio/visual presentations to specific skill development projects.

Item #10 "Teaching Goals for Reinforcing Basic Skills." Provide suggestions.

Item #11 "Seven Essential Workplace Basic Skills." Provide the information identified from a project by the American Society for Training and Development and the U.S. Department of Labor.

Item #15 "Factors to Consider When Developing a Lesson Plan." List the factors in a "how to" approach.

IX. How to apply student assessments that are criterion referenced:

Order and include the CBE Professional Development Series unit "Implementing Criterion-Referenced Evaluation" for use when teaching this objective.

Present relevant information in the green sheets. It is suggested in the series that this information be provided to participants prior to the workshop session.

Suggested activities, assignments, and a test are included in the unit.

Items of priority in the green sheets include:

Item #3 "Steps in the Alignment Concept." Begin with "determine intended outcomes," continue with "develop instructional strategies that teach toward outcomes," and end with "evaluate the same learner outcomes."

Items #4 and #5 "Descriptions and Characteristics of Norm-Referenced Evaluation and Criterion-Referenced Evaluation." Provide a review and comparison table.

Item #6 "Descriptions of the Domains of the Taxonomy of Educational Objectives." Provide a review.

Items #8 and #9 "Advantages and Limitations of Types of Written Test Items" and "Major Advantages and Disadvantages of Using a Performance Test as an Evaluation Tool." Present comparisons.

Item #10 "Types of Instruments Used to Assess Student Attitudes and Values." Provide examples of five methods.

X. How to use student competency profiles:

Describe the purpose of competency profiles.

Present the essential elements included in a competency profile.

Describe how to use a competency profile.

Describe the advantages of a competency profile.

Provide samples of quality competency profiles to participants.

Discuss software tools used to develop/format the profile document.

Provide resources for desktop publishing assistance.

XI. Review of resources, Mentoring Plan, Evaluation of workshop, Closure:

Provide a brief overview of the materials included in the "Resources" section of participant materials.

Describe the Mentoring Plan.

Ask participant to complete the "Workshop Evaluation" form.

Thank participants for their attendance.

Collect evaluation sheets.

RESOURCES

Components of a Quality Syllabus

Course Information: *Put this first and include the following:*

Course Title
Course Number
Credit Hours
Prerequisites
Instructor Permission
Classroom Location
Days and Hours Class/Lab Meets

Instructor Information: *This follows course information. Include teaching assistants and the following:*

Instructor's Full Name and Title
Office Location and Hours (also where to leave assignments)
Office Phone Number (possibly an emergency number also)
Home Phone Number (with restrictions on calling times)
Office Hours

Texts, Readings, Materials: *This contains detailed information about course readings and print material:*

Textbooks
- Title, author, date, edition, publisher, cost, where available (can include why this reference was selected and how often it will be used)

Supplementary Readings
- Same Bibliographic information as Textbooks
- Indicate recommended/required
- Library reserve/purchase

Materials
- Lab/safety equipment
- Art supplies, calculators, computers, software

Course Description: *This should be consistent with the College's catalog:*

Paragraph on general content
Why course is important
Include instructional methods (lecture, discussion)

Course Objectives: *State what students do and identify expectations. Include these elements:*

Statement of the learning outcome
The condition(s) for outcome achievement
Acceptable standard or level of achievement

Course Calendar/Schedule: *State that this is tentative and subject to change:*

Weekly schedule of topics
Exam, quiz, and other assessment dates
Due dates for major assignments
Required special events

Course Policies: *Parity is needed with College Board policies:*

Attendance/lateness
Class participation
Missed exams or assignments
Lab safety/health
Academic dishonesty

Grading:

Factors for evaluation and weighting
How factors translate to grades
Appeals procedures
Extra credit options

Available Support Services: *Provide a listing of instructional support services:*

Library
Learning Center
Computers

Source: Idea Paper No. 27: "Writing a Syllabus," September, 1992 and Idea Paper No. 18, "Matching Instructional Objectives, Subject Matter, Tests, and Score Interpretations," September, 1987. Center for Faculty Evaluation and Development, Division of Continuing Education, Kansas State University.

SCANS

The Secretary's Commission on Achieving Necessary Skills

A Practical Guide for Identifying and Using

SCANS Competencies in

Technical/Occupational Programs

Revised June 1995

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INTRODUCTION

In 1990, the Secretary's Commission of Achieving Necessary Skills (SCANS) was asked to examine the demands of the workplace and whether our young people are capable of meeting those demands. Specifically the commission was directed to advise the Secretary of Labor on the level of skills required to enter employment. In carrying out this charge, the Commission was asked to:

-- Define the skills needed for employment;
-- Propose acceptable levels of proficiency;
-- Suggest effective ways to evaluate proficiency, and;
-- Develop a dissemination strategy for the nation's schools, businesses, and homes.

The initial results of this commission's work was the development of a series of five competencies and the three-part foundation skills upon which the competencies are built.

For all that has been done to date, much work remains. For example, at the college level, we have been directed by the Texas Higher Education Coordinating Board to insure that program content includes competencies and provides proficiency in basic work-place transferable skills, such as those defined by the SCANS report.

Unfortunately, practical approaches for meeting this requirement have been lacking. The purpose of this booklet, therefore, is to help fill this information void by offering some practical options by which you may 1) effectively identify the SCANS competencies addressed in a course or technical/occupational program, and 2) use the SCANS competencies as a quality control/continuous improvement tool.

The information here is not intended to be the "only way" or the "best way". Rather, it serves as a starting point that will hopefully serve as a springboard for other new ideas. In time there may be as many methodologies for incorporating SCANS competencies as there are recipes for making a chocolate cake. I invite your questions, comments, and ideas in this endeavor.

Ike Buddin
Curriculum Specialist

SCANS WORKPLACE COMPETENCIES

Basic SCANS competencies and foundations are shown in boldface. This table includes an expanded list of SCANS competencies. This expanded list goes beyond what is currently required by the Texas Higher Education Coordinating Board. It is recommended, however, as a better indicator of program and course effectiveness. The breakdown under each heading may be determined at the local level. For this reason, definitions in Appendix A do not necessarily correspond with the sub-competencies shown here.

1. SCANS COMPETENCIES.

a. Resources. Allocating:
- (1) Time
- (2) Money
- (3) Materials
- (4) Space
- (5) Staff

b. Interpersonal Skills:
- (1) Working on teams
- (2) Teaching others
- (3) Serving customers
- (4) Leading
- (5) Negotiating
- (6) Working with different cultures

c. Information:
- (1) Acquiring and evaluating data
- (2) Organizing and maintaining info.
- (3) Interpreting and communicating
- (4) Processing information with computers

d. Systems
- (1) Understanding social, technological, and organizational systems
- (2) Monitoring and correcting performance
- (3) Designing and/or improving systems

e. Technology
- (1) Selecting equipment & tools
- (2) Applying technology to specific tasks
- (3) Maintaining & troubleshooting technologies

2. SCANS FOUNDATIONS

a. Basic Skills
- (1) Reading
- (2) Writing
- (3) Arithmetic/Mathematics
- (4) Speaking
- (5) Listening

b. Thinking Skills
- (1) Thinking creatively
- (2) Making decisions
- (3) Solving problems
- (4) Seeing with the mind's eye
- (5) Knowing how to learn and reason

c. Personal Qualities
- (1) Individual responsibility
- (2) Self-esteem
- (3) Sociability
- (4) Self-management
- (5) Integrity

BEST COPY AVAILABLE

PART 1.
IDENTIFYING SCANS COMPETENCIES ADDRESSED IN AN ESTABLISHED COURSE/PROGRAM

A. Matching Course Materials to SCANS Competencies.

The following information is designed to help you identify the SCANS competencies within an existing course or program. By conducting this SCANS analysis, you'll give yourself a baseline for determining how well your curriculum currently works in developing specific competencies.

Before you conduct a comparative analysis between a course and the SCANS competencies addressed in that course, there are some fundamental issues to be determined.

(1) What course materials should I work with? That depends on what materials you have available. Probably the best place to begin is with the syllabus. Does it state specific student learning outcomes for the course? Are the statements well written, having one action verb linked to one object? Is each outcome clearly stated? If you can answer "yes" to these questions, look no further. If not, you *may* not be ready to conduct a SCANS analysis. Much depends on how you choose to conduct the analysis.

(2) How should I conduct the analysis? There are several approaches you can apply to determine the SCANS competencies addressed within a course or program. These approaches can be extremely liberal or extremely restrictive in making the connection, or they can be somewhere in-between. Listed below are a list of approaches you could opt for. They're basically arranged from the most general approach to the most specific.

-- Work with a list of courses and a list of the 8 basic SCANS competencies (*see page 3*). Match each course to the relevant competencies.

-- Work with a list of courses and an expanded list of SCANS competencies (*see page 3*). Match each course with the more specific SCANS competencies.

-- Work with a list of course outcomes and a list of the 8 basic SCANS competencies. Match each course outcome to the SCANS competencies.

-- Work with a list of course outcomes and an expanded list of SCANS competencies. Match each course outcome to the more specific SCANS competencies.

-- Assimilate all the formal examinations, special project assignments, and other materials for which students earn a grade or are required to complete for the course. Using a list of the 8 basic SCANS competencies, identify the competencies students must apply to complete the examination/ project. **NOTE:** In the absence of learning outcomes for each course, this and the following approach are probably the only ways you can conduct a valid analysis.

-- Collect all the formal examinations, special project assignments, and other materials for which students earn a grade or are required to complete for the course. Using an expanded list of SCANS competencies, identify the competencies students must apply to complete the examination/project.

(3) How may I document my work? There is a variety of forms easily used to document the SCANS analysis. The two most common ones are included in Appendix B. These forms are based on the use of learning outcomes (or similar statements of student achievement) and an expanded list of SCANS competencies to conduct the analysis.

(4) How can I validate the accuracy of my work? There are some basic questions you should ask when determining if a course outcome accurately addresses a SCANS competency. In answering these questions, you'll have to call on individual skills of curriculum development, your awareness of what employers require, and how the overall program is structured. Below are six "tests" that you may use to evaluate your decisions. Not all of these tests are relevant to every situation, so use them with discretion.

-- **The Practical Appication Test.** Some instructors think that they must specifically teach a particular SCANS competency for it to be counted. This is not the case. Rather, the focus of the SCANS competencies is what the student can do, not what the instructor has taught. The practical application test, therefore, asks the question, "Does the learning outcome/test item require the student to practically apply this ability?" For example, a learning outcome may require a student to use Lotus 1-2-3, a computer spreadsheet package, to develop a basic checkbook ledger. Although Lotus is a powerful mathematics tool, such an outcome would not develop a student's basic arithmetic/mathematics skills because the s/he isn't required to apply these skills to develop the ledger.

-- **The Domain Test.** Each SCANS competency lends itself to a particular domain (cognitive, psychomotor, or affective).

For example, personal responsibility, one of the SCANS personal qualities, has an affective orientation. Processing information with computers, one of the SCANS information competencies, is primarily psychomotor. If the domain of the learning outcome matches the primary domain of the SCANS competency, it passes this test.

-- **The Level of Learning Test.** This is an extension of the domain test. Some SCANS competencies call for a very basic level of learning, while others imply a higher level. In the category of Technology, for example, there can be a big difference between applying technology to a particular task and having the ability to apply maintenance and troubleshooting skills (depending on the technical field). There are two questions you can ask in this area: 1) Does the action verb used in the learning outcome correlate with the general level of learning implied within the SCANS competency? 2) Would you expect a student to demonstrate a high level of competence in an introductory or other 100-level course?

-- **The Occupational Perspective Test.** Would a prospective employer of your students agree that a course (or program) effectively develops a SCANS competency? Can you point to information in a validated DACUM Chart to verify this? (Remember, the SCANS competencies are primarily based on workplace competencies.)

-- **The Logical Relationship Test.** This is another commonly-used approach, especially for cognitive-domain learning outcomes or test items. It asks the question, "Is there a logical relationship between the learning outcome/test item and the SCANS competencies?" You may wish to refer to the definitions in Appendix A to help validate your decisions. However, professional judgement is often the most practical and relevant approach, since Appendix A is very general in nature.

-- **The "Where's the Beef?" Test.** This may be the ultimate test. The "Beef" is in each test item, examination, term paper, etc. you give your students. This, of course, is where you formally hold the student accountable for a knowledge or skill. Are you testing the students in a manner that requires them to demonstrate a SCANS competency?

PART 2.
USING THE SCANS COMPETENCIES AS A QUALITY CONTROL/CONTINUOUS IMPROVEMENT TOOL.

I recently conducted a SCANS analysis of several courses in one of our technical/occupational programs. In the basic skills section, I frequently identified that 4 out of the 5 competencies were addressed in most courses; the one basic skill missing was arithmetic/mathematics. When the instructor looked at my findings, she was curious as to why I didn't check off this line item. I explained that there was nothing in the learning outcomes that indicated the students' need to apply these skills. She was shocked that this was the case, for she maintained that students did indeed have to apply such skills.

Admittedly, I am a novice in her field of expertise, but if I can't find evidence that a certain competency will be needed (or developed), then probably, neither can the students (or some other important individuals).

This gives rise to a different opportunity the SCANS competencies -- especially, the expanded list -- give us. There are probably dozens of ways you can ultimately use SCANS competencies as a measure of quality or to promote continuous improvement. Here is a simple recipe you may wish to use to make sure certain competencies are adequately addressed in a course or program:

-- Before you begin a SCANS analysis, determine which SCANS competencies you want to address or build into each course.

-- Develop or revise the curriculum content/learning outcomes for each course in the usual fashion.

-- Match each learning outcome with the SCANS competencies as addressed in Part 1. Validate your results.

-- Refer to the original list of SCANS competencies you intended to address. If any SCANS competencies selected in the first step aren't adequately addressed, revise or add to the curriculum to reach the standards you originally established.

APPENDIX A.
General Definitions for the SCANS Competencies

These definitions are reproduced from "What Work Requires from Schools; A SCANS Report for America 2000," Appendices B and C.

RESOURCES

Manages Time Selects relevant, goal-related activities, ranks them in order of importance, allocates time to activities, and understands, prepares, and follows schedules.

Manages Money Uses or prepares budgets, including making cost and revenue forecasts; keeps detailed records to track budget performance; and makes appropriate adjustments.

Manages Material and Facility Resources Acquires, stores, and distributes materials, supplies, parts, equipment, space, or final products in order to make the best use of them.

Manages Human Resources Assesses knowledge and skills, distributes work accordingly, evaluates performance, and provides feedback.

INTERPERSONAL SKILLS

Participates as a Member of a Team Works cooperatively with others and contributes to group efforts with ideas, suggestions, and effort.

Teaches Others Helps others learn needed knowledge and skills.

Serves Clients/Customers Works and communicates with clients and customers to satisfy their expectations.

Exercises Leadership Communicates thoughts, feelings, and ideas to justify a position, encourage, persuade, convince, or otherwise motivate an individual or groups, including responsibility challenging existing procedures, policies or authority.

Negotiates to Arrive at a Decision Works toward an agreement that may involve exchanging specific resources or resolving divergent interests.

Works with Cultural Diversity Works well with men and women and with people from a variety of ethnic, social, or educational backgrounds.

INFORMATION

Acquires and Evaluates Information Identifies a need for data, obtains the data from existing sources or creates them, and evaluates their relevance and accuracy.

Organizes and Maintains Information Organizes, processes, and maintains written or computerized records and other forms of information in a systematic fashion.

Interprets and Communicates Information Selects and analyzes information and communicates the results to others using oral, written, graphic, pictorial, or multimedia methods.

Uses Computers to Process Information Employs computers to acquire, organize, analyze, and communicate information.

SYSTEMS

Understands Systems Knows how social, organizational, and technological systems work and operates effectively within them.

Monitors and Corrects Performance Distinguishes trends, predicts impacts of actions on system operations, diagnoses deviations in the functioning of a system/organization, and takes necessary action to correct performance.

Improves and Designs Systems Makes suggestions to modify existing systems in order to improve the quality of products or services and develops new or alternative systems.

TECHNOLOGY

Selects Technology Judges which sets of procedures, tools, or machines, including computers and their programs, will produce the desired results.

Applies Technology to Task Understands the overall intents and the proper procedures for setting up and operating machines, including computers and their programming systems.

Maintains and Troubleshoots Technology Prevents, identifies, or solves problems in machines, computers and other technologies.

THE FOUNDATION SKILLS

BASIC SKILLS

Reading Locates, understands, and interprets written information in prose and documents--including manuals, graphs, and schedules--to perform tasks; learns from text by determining the main idea or essential message; identifies relevant details, facts, and specifications; infers or locates the meaning of unknown or technical vocabulary; and judges the accuracy, appropriateness, style, and plausibility of reports, proposals, or theories of other writers.

Writing Communicates thoughts, ideas, information, and messages in writing; records

information completely and accurately,; composes and creates documents such as letters, directions, manuals, reports, proposals, graphic and flow charts with the language, styles, organization, and format appropriate to the subject matter, purpose, and audience; includes, where appropriate, supporting documentation, and attends to level of detail; and checks, edicts, and revises for correction information, appropriate emphasis, form, grammar, spelling, and punctuation.

Arithmetic Performs basic computations; uses basic numerical concepts such as whole numbers and percentages in practical situations; makes reasonable estimates of arithmetic results without a calculator; and uses tables, graphs, diagrams, and charts to obtain or convey quantitative information.

Mathematics Approaches practical problems by choosing appropriately from a variety of mathematical techniques; uses quantitative data to construct logical explanations for real world situations; expresses mathematical ideas and concepts orally and in writing; and understands the role of chance in the occurrence and prediction of events.

Listening Receives, attends to, interprets, and responds to verbal messages and other cues such as body language in ways that are appropriate to the purpose--for example, to comprehend, learn, critically evaluate, appreciate, or support the speaker.

Speaking Organizes ideas and communicates oral messages appropriate to listeners and situations; participates in conversation, discussion, and group presentations; selects an appropriate medium for conveying a message; uses verbal language and other cues such as body language in a way appropriate in style, tone, and level of complexity to the audience and the occasion; speaks clearly and communicates a message; understands and responds to listener feedback; and asks questions when needed.

THINKING SKILLS

Creative Thinking Generates new ideas by making nonlinear or unusual connections, new possibilities; and uses imagination freely, combining ideas or information in new ways, making connections between seemingly unrelated ideas, and reshaping goals in ways that reveal new possibilities.

Decision Making Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternatives.

Problem Solving Recognizes that a problem exists (i.e., that there is a discrepancy between what is and what should be); identifies possible reasons for the discrepancy, and devises and implements a plan for action to resolve it; and evaluates and monitors progress, revising the plan as indicated by findings.

Mental Visualization Sees things in the mind's eye by organizing and processing symbols, pictures, graphs, objects, or other information--for example, sees a building from a blueprint, a

system's operation from schematics, the flow of work activities from narrative descriptions, or the taste of food from reading a recipe.

Knowing How to Learn Recognizes and can use learning techniques to apply and adapt existing and new knowledge and skill sin both familiar and changing situations; and is aware of learning tools such as personal learning styles (visual, aural, etc.), formal learning strategies (notetaking or clustering items that share some characteristics), and informal learning strategies (awareness of unidentified false assumptions that may lead to faulty conclusions).

Reasoning Discovers a rule or principle underlying the relationship between two or more objects and applies tit in solving a problem--for example, uses logic to draw conclusions from available information, extracts rules or principles from a set of objects or a written text, or applies rules and principles to a new situation (or determines which conclusions are correct when given a set of facts and conclusions).

PERSONAL QUALITIES

Responsibility Exerts a high level of effort and perseverance toward goal attaintment; works hard to become excellent at doing tasks by setting high standards, paying attention to details, working well even when assigned an unpleasant task, and displaying a high level of concentration; and displays high standards of attendance, punctuality, enthusiasm, vitality, and optimism in approaching and completing tasks.

Self-Esteem Believes in own self-worth and maintains a positive view of self, demonstrates knowledge of own skills and abilities, is aware of one's impression on others, and knows own emotional capacity and needs and how to address them.

Sociability Demonstrates understanding, friendliness, adaptability, empathy, an politeness in new and ongoing group settings; asserts self in familiar and unfamiliar social situations; relates well to others; responds appropriately as the situation requires; and takes an interest in what others say and do.

Self-Management Accurately assesses own knowledge, skills, and abilities; sets well-defined and realistic personal goals; monitors progress toward goal attainment and motivates self through goal achievement; and exhibits self-control and responds to feedback unemotionally and nondefensively.

Integrity/Honesty Recognizes when being faced with making a decision or exhibiting behavior that may break with commonly held personal or societal values; understands the effects of violating these beliefs and codes on an organization, oneself, and others; and chooses an ethical course of action.

Appendix B.

Sample Workforms.

Course: _____ SCANS Competencies/Foundations	Relevant Learning Outcomes (Identify by learning outcome number only)
1. SCANS COMPETENCIES.	
a. Resources. Allocating:	
(1) Time	(1)
(2) Money	(2)
(3) Materials	(3)
(4) Space	(4)
(5) Staff	(5)
b. Interpersonal Skills:	
(1) Working on teams	(1)
(2) Teaching others	(2)
(3) Serving customers	(3)
(4) Leading	(4)
(5) Negotiating	(5)
(6) Working with different cultures	(6)
c. Information:	
(1) Acquiring and evaluating data	(1)
(2) Organizing and maintaining information	(2)
(3) Interpreting and communicating	(3)
(4) Processing information with computers	(4)
d. Systems	
(1) Understanding social, technological, and organizational systems	(1)
(2) Monitoring and correcting performance	(2)
(3) Designing and/or improving systems	(3)
e. Technology	
(1) Selecting equipment & tools	(1)
(2) Applying technology to specific tasks	(2)
(3) Maintaining & troubleshooting technologies	(3)
2. SCANS FOUNDATIONS	
a. Basic Skills	
(1) Reading	(1)
(2) Writing	(2)
(3) Arithmetic/Mathematics	(3)
(4) Speaking	(4)
(5) Listening	(5)
b. Thinking Skills	
(1) Thinking creatively	(1)
(2) Making decisions	(2)
(3) Solving problems	(3)
(4) Seeing with the mind's eye	(4)
(5) Knowing how to learn and reason	(5)
c. Personal Qualities	
(1) Individual responsibility	(1)
(2) Self-esteem	(2)
(3) Sociability	(3)
(4) Self-management	(4)
(5) Integrity	(5)

Checklist for Identifying SCANS Competencies/Foundations	Course Numbers											
Program: _____												
1. SCANS COMPETENCIES.												
a. Resources. Allocating:												
(1) Time												
(2) Money												
(3) Materials												
(4) Space												
(5) Staff												
b. Interpersonal Skills:												
(1) Working on teams												
(2) Teaching others												
(3) Serving customers												
(4) Leading												
(5) Negotiating												
(6) Working with different cultures												
c. Information:												
(1) Acquiring and evaluating data												
(2) Organizing and maintaining information												
(3) Interpreting and communicating												
(4) Processing information with computers												
d. Systems												
(1) Understanding social, technological, and organizational systems												
(2) Monitoring and correcting performance												
(3) Designing and/or improving systems												
e. Technology												
(1) Selecting equipment & tools												
(2) Applying technology to specific tasks												
(3) Maintaining & troubleshooting technologies												
2. SCANS FOUNDATIONS												
a. Basic Skills												
(1) Reading												
(2) Writing												
(3) Arithmetic/Mathematics												
(4) Speaking												
(5) Listening												
b. Thinking Skills												
(1) Thinking creatively												
(2) Making decisions												
(3) Solving problems												
(4) Seeing with the mind's eye												
(5) Knowing how to learn and reason												
c. Personal Qualities												
(1) Individual responsibility												
(2) Self-esteem												
(3) Sociability												
(4) Self-management												
(5) Integrity												

IV. Conclusions and Recommendations

Conclusions

All proposed Project objectives and activities were completed during this Project phase. These conclusions are a result of conducting these activities:

- Faculty development in the form of multi-media communication was successful and well-received by the faculty; therefore, it is recommended The Internet and "Home Page" format be developed and tested as an enhanced delivery method.
- Curriculum enhancements, in the form of revising syllabi and implementing learning activities, were successfully implemented; therefore, it is recommended the remainder of the syllabi for the Electrical Technology program courses be revised to reflect SCANS infusion and enhanced activities.
- The "Electrical Construction Occupations" document from the U. S. Electrical Construction Industry Skill Standards and Certification Project was a valuable report which validated the technical content and SCANS emphasis in the enhanced Electrical Technology program; therefore, it is recommended the National Skill Standards for the Electrical Industry be utilized, when available, to compare/align the ET curriculum with the national standards for the electrical construction industry.
- Testing and assessment enhancements, in the form of ACT *Work Keys* assessments, Competency-profiles, and computer-based testing, were worthwhile

activities; therefore, it is recommended the competency-profiles and computer-based testing be completed for the remaining courses in the Electrical Technology program. Pre and post testing needs further study; therefore, it is recommended that the Project would participate in an advisory capacity with Richland college's testing study during the next Project year.

- Faculty development, in the form of SCANS integration and technical assistance, proved successful activities; therefore, it is recommended that competency-based instruction and technical assistance be provided to faculty in the next Project year.

Finally, it was noted in this phase of Project activity that it would be beneficial for each of the four Projects to continue efforts to cooperate and to identify specific areas for collaboration for the future; therefore, it is recommended the North Lake College Skill Standards and Certification Project continue collaboration with the three other Projects.

Recommendations

The following table depicts in a matrix form the recommendations, rationale and action items proposed for this Project. These recommendations are offered for the purpose of giving direction to future initiatives associated with the North Lake College Skill Standards and Certification Project.

Recommendations	Rationale	Action Item
National Skill Standards for Electrical Construction Industry Alignment with North Lake College Electrical Technology Program Curriculum	The National Skill Standards are projected to be available this summer--to bring closure to the Project the skill standards must be aligned	*An analysis of the curriculum would be conducted comparing the national skill standards to the curriculum to determine alignment*
National Skill Standards for Electrical Construction Industry Alignment with Dallas Electrical Joint Apprenticeship and Training Program Curriculum	The National Skill standards are projected to be available this summer--to bring closure to the Project the skill standards must be aligned	*An analysis of the curriculum would be conducted comparing the national skill standards to the curriculum to determine alignment*
Faculty Development using The Internet System and Home Page Format	Access to The Internet is now widespread and faculty can learn about a variety of topics in this convenient manner--more can be reached with slim resources in this way	*A "Home Page" format would be developed and information would be regularly featured in this forum on a variety of topics including SCANS, skill standards and School to Work, etc*

Recommendations	Rationale	Action Item
Technical Support for Faculty using The Internet System and "Home Page" Format	Internet affords faculty a means of obtaining technical assistance by querying The Internet and getting responses to their information needs.	*Project staff would provide responses to faculty inquiries and assistance to questions that are posted on the Internet as well as disseminate information in a dialogue fashion*
Curriculum Revisions for the North Lake College Electrical Technology Program	Continued work with the NLC ET Program is warranted to complete the course syllabi and SCANS crosswalk activities for all ET courses in the curriculum as well as continue identification of learning activities	*Project staff and consultants would work with the ET Program Coordinator to develop the enhanced course syllabi to reflect the documentation of SCANS and learning activities that support the performance activities*
Competency-Based Instruction and SCANS Integration	Faculty development activities are needed in CBE and SCANS infusion for faculty groups and individual faculty as well as resource material that can be referenced when developing the curriculum	*Project staff would conduct CBE sessions and provide consultation and technical assistance to faculty in group and individual delivery methods; Project staff would provide a resource library for faculty to reference when they are providing mentoring services*
Technical Support on SCANS infusion and the process model for Texas Public and Community Colleges	Community and public colleges in Texas would need assistance with how the process model is employed to infuse SCANS into the curriculum	*Project staff would provide technical assistance through group presentations and individual consultations with faculty, curriculum specialists and other individuals interested in using the process model for SCANS infusion*

Recommendations	Rationale	Action Item
Collaboration with the three other Skill Standards Projects on Lead Activities	All four Skill Standards Projects funded under this initiative could share their discoveries and the strengths of their findings	*The four Projects would convene on a quarterly basis in an advisory role for each project; the Projects would assist each other with lead activities where appropriate*

V. Appendix

Appendix A: ACT *Work Keys* Occupational Profile for Construction Electrician

Appendix B: Sample Wiring Diagram and Assignments

Appendix C: "Electrical Construction Operations" Report

Appendix D: ACT *Work Keys* Test Descriptions

Appendix A:

ACT *Work Keys* Occupational Profile for Construction Electrician

ACT

Work Keys Profile

Occupation Title: **Electrician (construction)**
Total Number of Subject Matter Experts: 8
Number of Employers Represented: 8
Number of SME Groups: 1
March 10, 1994

Reading for Information	*Applied Mathematics*	*Listening*	*Writing*	*Locating Information*	*Teamwork*	*Applied Technology*
5 or 6	6 or 7	4	3 or 4	5	3	5

Briefly, profiling involved the following four steps:

1. Developing a list of the most critical tasks to the occupation;
2. Sorting the tasks into categories associated with each *Work Keys* skill;
3. Identifying on-the-job behaviors associated with each skill as it is used in the occupation;
4. Determining the *Work Keys* skill levels of the occupation.

As the initial step, subject matter experts (SMEs), consisting of employees identified as having firsthand knowledge of the requirements of the occupation, reviewed a task list taken from the *Dictionary of Occupational Titles* for relevance and comprehensiveness. They deleted any tasks they considered unimportant, revised some task statements, and added tasks that they considered important to the occupation. The SMEs rated each task on both IMPORTANCE, the significance of the task to overall occupational performance, and RELATIVE TIME SPENT, the amount of time spent performing this task compared to other tasks. The CRITICALITY of each task to the occupation (the multiplication of IMPORTANCE and RELATIVE TIME SPENT) was then calculated. The SMEs reviewed the list of tasks and their CRITICALITY ratings and revised the list so that only the most critical tasks remained.

Using this list of most critical tasks, the SMEs discussed how the *Work Keys* skills (i.e., *Applied Mathematics*, *Reading for Information*, etc.) were required for effective performance of each task, and then sorted the tasks into categories associated with each skill (tasks could be sorted into more than one category). Guided by these new lists, the SMEs identified on-the-job behaviors and activities that required the skill, such as reading manuals, calculating the sum of a list of numbers, etc. Finally, the SMEs reviewed the descriptions of the *Work Keys* skills to determine the levels of *Reading for Information*, *Applied Mathematics*, *Listening*, *Writing*, *Locating Information*, *Teamwork* and *Applied Technology* needed to perform the tasks of the occupation.

The resulting profile determined by the SMEs is presented in the table at the top of this page. The most critical tasks and a description of the *Work Keys* skills levels for this occupation are presented on the following pages.

ACT

Profile Comments

The purpose of conducting a profile for the Electrician (construction) occupation was to use the resulting information for curriculum development. For this reason, the SMEs were instructed to think of the skill levels needed for an individual entering the occupation (i.e., at the apprentice level). The task list, however, represents tasks performed by journeyman electricians (the designation for an individual who has completed the five year apprenticeship program). This approach was taken to the task list because apprentices are not expected to be able to perform any electrician tasks when they enter the apprenticeship program so a task list for apprentices does not exist. The discussion among the SMEs regarding appropriate skill levels resulted in a number of interesting observations which are summarized below.

Reading for Information: Six members of the group said individuals need to enter the apprenticeship program at Level 6 of this skill. The remaining two members of the group felt that setting the level at Level 6 would exclude too many people from the occupation and felt Level 5 of this skill would be appropriate for entry-level. The training coordinator, who participated in the meeting, mentioned that most applicants for the program are not at Level 6. He went on to note that the dropout rate is 30% to 40% for Year 1. The implication was that the dropout rate may decline if individuals enter the occupation with higher skill levels.

Applied Mathematics: Six members of the group felt entry-level people should be at Level 6 of this skill and that they would move up to Level 7 during the apprenticeship program. Two group members said basic algebra is needed in the occupation and felt Level 7 was more appropriate. The training coordinator noted that the apprenticeship program does include a refresher course in mathematics.

Listening: The group members agreed that a great deal of an apprentice's job is to listen either during classroom instruction or while working on the job with a journeyman electrician. There was clear agreement among the group that Level 4 is the appropriate level of this skill to require at entry-level.

Writing: Six members of the group felt individuals could start the apprenticeship program at Level 3 of this skill, while the remaining group members felt Level 4 was more appropriate. The group noted that, in their opinion, most of the current workforce is at Level 3.

Locating Information: The group was in clear agreement that Level 5 was the appropriate level of this skill to require at entry-level.

Teamwork: After some discussion, the group decided that Level 3 was the appropriate level of this skill to require at entry-level. The discussion focused around conflict that can occur in work groups and the SMEs decided that problems were handled in a speedy manner prior to getting out of control.

Applied Technology: The group was in clear agreement that Level 5 was the appropriate level of this skill to require at entry-level.

ACT

Final Task List

1. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools such as hacksaws, pipe threaders, and conduit benders.
2. Works and coordinates with others (including people practicing other crafts) to complete assigned projects.
3. Cuts wires, cables, conduit, and raceway, threading and reaming conduit, boring and cutting chases under the direction of the foreman.
4. Provides prompt and efficient service to customers by responding quickly to customer work orders.
5. Connects wiring to accessories, such as relays, circuit breakers, plugs, condensers, switches, and solenoids; and installs accessory assemblies in electrical or electronic units using soldering gun and handtools.
6. Uses the proper rigging to pull wire and communication cable of all sizes through conduit, cable trays, and all other raceways using proper hand tools and power tools.
7. Works safely to prevent on the job injuries by using appropriate safety equipment, such as rubber gloves and sleeves, and methods such as, grounding line equipment and jumpers.
8. Connects conductors to switches, receptacles, or appliances with proper methods of splicing, or soldering and taping.
9. Connects wiring to lighting fixtures and power equipment using handtools.
10. Installs control, distribution, and electronic apparatus, such as switches, relays, and circuit-breaker panels, programmable controllers; using hand tool and power tools to fasten in place with screws or bolts.
11. Lays out the various outlets, switches, receptacles, and other details of the job from blueprints or by direction of the superintendent of construction.
12. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes.
13. Plans, lays outs, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment using hand tools and power tools.
14. Splices wires by stripping insulation from terminal leads (using a knife or wire strippers), twisting or soldering wires together, and applying tape or terminal caps or necessary lugs.
15. Uses measuring instruments, such as rulers, plumb-bobs, levels, and wire gauges.
16. Reads and understands construction standards manual and is familiar with electrical codes.
17. Uses measuring instruments such as volt meters, ohm meters, and amp meters.
18. Interprets maintenance manuals, schematics, and wiring diagrams, and repairs equipment, utilizing knowledge of electronics and using standard test instruments using handtools and power tools.
19. Reads work order to determine installation procedures specified by supervisor/technician.
20. Studies and understands electrical theory (Ohm's Law; single-phase and three-phase circuits; and vectors, voltage drops, series and parallel circuits).
21. Tests circuits and electric components to locate grounded wires, broken connections, or defective current-control mechanisms using electrical testing instruments.
22. Installs and connects single-phase and three-phase bank transformer connections and capacitor banks/voltage regulators.

Final Task List (continued)

23. Attends regular safety meetings and reads distributed material regarding new safety procedures.
24. Completes company paperwork such as truck inspection forms, time sheets, panel and transformer cards, accident reports, work orders, and oil spill sheets.
25. Performs and understands switching procedures of the distribution and transmissions system and fills out appropriate paperwork.
26. Prepares sketches or as-built drawings showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring.
27. Suggests improvements in work methods by reviewing current procedures and using on-the-job experience to make tasks more efficient.
28. Troubleshoots, repairs, and maintains, in accordance with diagrams, sketches, operation manuals, and manufacturer's specifications, machinery and equipment, such as transformers, tools, regulators, reclosers, capacitors, switches, fuses, and cut-outs.
29. Takes measurements, such as street and building dimensions, distances to be spanned by wire and cable, or space available in existing buildings and underground vaults, which affect installation and arrangement of equipment.
30. Operates radio to communicate with coworkers and dispatchers.
31. Recognizes and identifies the wide variety of conductors, such as underground and overhead.
32. Assesses work environment for proper wiring methods and materials in hazardous locations.
33. Digs trench and lays underground cable and conduit to connect source of power to customer's building, setup outdoor lighting as well as laying underground cable and conduit for data and communications (commercial, industrial, and residential).
34. Drives and operates vehicles and equipment, such as trucks (may be required to have commercial driver's license), trenchers, and tractors.
35. Installs and replaces duct systems and underground cable (works in underground vaults where cables are located).
36. Installs, maintains, and repairs pedestals, equipment pads, switching cabinets, padmounted transformers, and other underground equipment.
37. Locates cable and faults using fault and/or cable locating equipment.
38. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement.
39. Removes obstructions (steel structures, manhole covers, substation enclosures) and material in inorder to gain access to and remove defective parts or perform maintenance, using hoists, personnel lifts, cranes, handtools and power tools.
40. Replaces defective components and parts, such as transistors, coils, and integrated circuits, using soldering iron, wire cutters, hand tools, and power tools.
41. Works on energized lines with rubber gloves, mats and blankets and/or live line tools.
42. Terminates, splices, and tests cable according to manufacturer specifications.
43. Uses transit and tripod to establish grade and elevation.
44. Cuts and welds steel structural members using flame cutting and welding equipment.

ACT

Skill Level Descriptions

Electrician (construction) Occupation

Reading for Information Levels: 5 or 6

(Levels range from 3 to 7, "X" indicates skill is not applicable or is below Level 3)

Level 5

Employees must read moderately detailed and complicated company policies, procedures, and announcements. These reading materials contain words and phrases that may be specialized (jargon and technical language) or words that have several meanings. All of the information employees need is stated clearly in the reading materials, but the employees must consider several factors in order to identify the course of action that will accomplish their goals.

Employees are required to

- understand the paraphrased definition of specialized words or phrases (jargon or technical terms) defined in these reading materials.
- use jargon or technical terms appropriately in describing situations stated in these reading materials.
- understand the meaning of acronyms defined in these reading materials (an acronym is a word or collection of letters which stands for a longer phrase, such as HMO to mean Health Maintenance Organization).
- figure out which definition of a word with multiple meanings is appropriate in the context of these reading materials.
- apply information given in these reading materials to situations that are not directly described, but similar.
- apply instructions or procedures with a number of steps to described situations. These instructions may include conditionals (if X happens, then you should do Y).

Level 6

Employees must read difficult company policies, procedures, and announcements. These reading materials present complicated information; for example, they may include excerpts from regulatory and legal documents. These reading materials use advanced vocabulary, jargon, and technical terms to describe elaborate procedures and concepts. Most of the information employees need in order to identify an appropriate course of action is not clearly stated in the reading material. Thus, employees may need to determine the principles underlying the described situation and apply those principles to new situations not depicted in the reading material.

Employees are required to

- understand specialized words or phrases (jargon or technical terms) when used in an unfamiliar context.
- apply complicated information to new situations.
- figure out from context the less common meaning of a word with multiple meanings.

Skill Level Descriptions (continued)

Reading for Information Level 7 (continued)

- figure out the general principles underlying situations described in these reading materials and apply those principles to related situations.
- understand implied details.
- figure out the reasoning behind a procedure, policy, or communication.

Applied Mathematics Levels: 6 or 7

(Levels range from 3 to 7. "X" indicates skill is not applicable or is below Level 3)

Level 6

Employees are required to

- set up problems and do several steps of calculations or conversions.
- calculate using negative numbers, fractions, ratios, percentages, or mixed numbers (e.g., $12\frac{1}{2}$).
- transpose a formula before calculating (e.g., $v = ir \Rightarrow r = \frac{v}{i}$), or look up and use two formulas to change from one unit to another unit within the same system of measurement (e.g., 1 cup = 8 fl oz and 1 quart = 4 cups).
- find mistakes in calculations, such as those required in lower levels.

For example, employees might be required to calculate multiple rates, to find areas of rectangles and volumes of rectangular solids, or to solve problems that compare production rates and pricing schemes.

Level 7

Employees are required to

- do several steps of reasoning and calculations.
- solve problems involving more than one unknown and nonlinear functions (e.g., rate of change).
- find mistakes in multiple-step calculations.
- figure out the information needed to solve a problem when the information presented is incomplete or implicit.

For example, employees might be required to convert between systems of measurement that involve fractions, mixed numbers, decimals, or percentages; to calculate multiple areas and volumes of spheres, cylinders, or cones; or to set up and manipulate complex ratios or proportions.

Skill Level Descriptions (continued)

Listening Level: 4
(Levels range from 0 to 5)

Employees must understand all the important information from the spoken material. They may miss subtle details or tone or may have incorrect noncritical information that does not interfere with the main idea.

Writing Levels: 3 or 4
(Levels range from 0 to 5)

Level 3

Employees' writing must convey information clearly. Most of the sentences in the messages are complete. There are some mechanical errors which do not interfere with understanding the meaning. Writing does not contain slang.

Level 4

Employees' writing conveys information clearly. All of the sentences in the writing are complete, though they may be choppy. Writing does not contain any slang. There may be a few minor mechanical errors, but these errors do not interfere with understanding the meaning.

Locating Information Level: 5
(Levels range from 3 to 6, "X" indicates skill is not applicable or is below Level 3)

Employees must read complicated workplace graphics, such as detailed forms, tables, graphs, diagrams, instrument gauges, and maps.

Employees are required to

- summarize and/or compare information and trends in a single graphic.
- summarize and/or compare information and trends among more than one workplace graphic, such as a bar chart and a table showing related information.

Skill Level Descriptions (continued)

Teamwork Level: 3

(Levels range from 3 to 6. "X" indicates skill is not applicable or is below Level 3)

Employees are required to recognize the behaviors or actions which would best support the team and contribute to work performance when faced with simple work situations involving one problem or one issue that needs to be handled. In these work situations, the team goals and consequences are clear, all the resources needed to deal with the problems are available, and the relationship among team members is good.

Employees may be required to

- understand the goal that the team is trying to accomplish and how to work with other team members to accomplish that goal.
- choose actions that support the ideas of other team members and try to use their suggestions to accomplish team goals.
- determine if the team is having problems finishing a task and figure out what is causing these problems.

Applied Technology Level: 5

(Levels range from 3 to 6. "X" indicates skill is not applicable or is below Level 3)

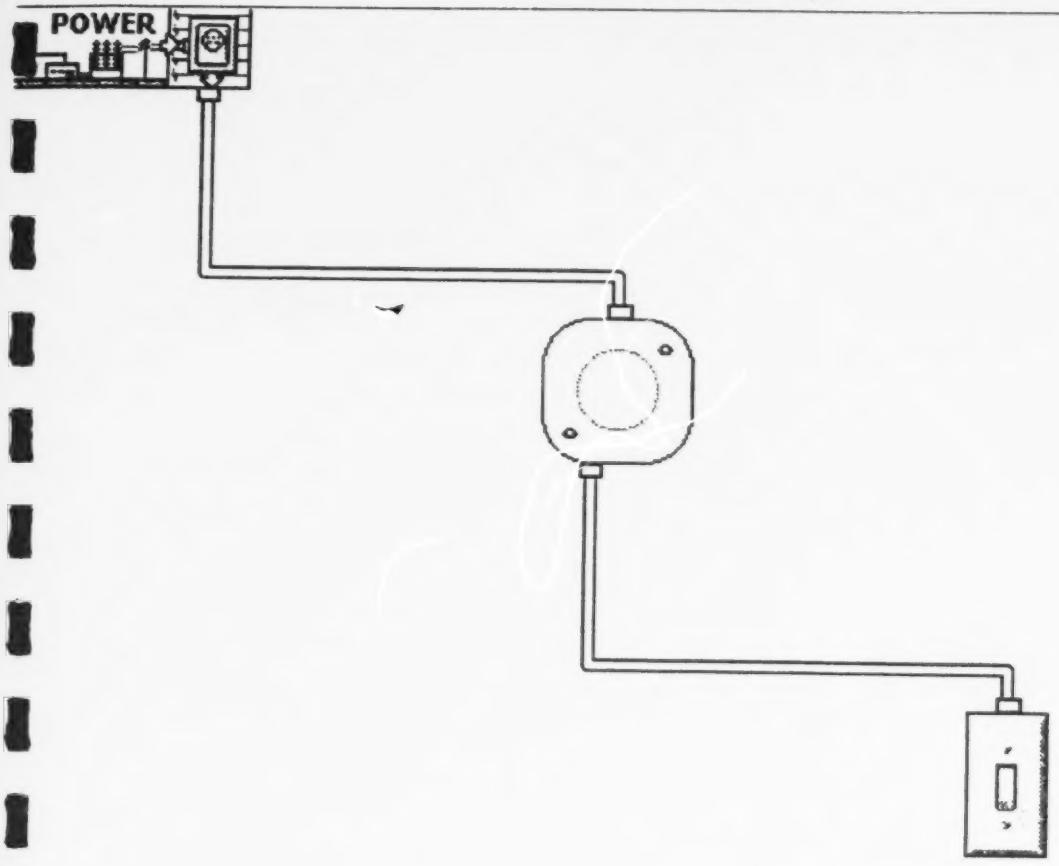
Employees are required to solve problems involving one **complex** system, or one or more uncomplicated tools or systems. In solving some of these problems, employees must apply **difficult** physical principles, such as phase change or pressure equilibrium in a system.

Employees are required to

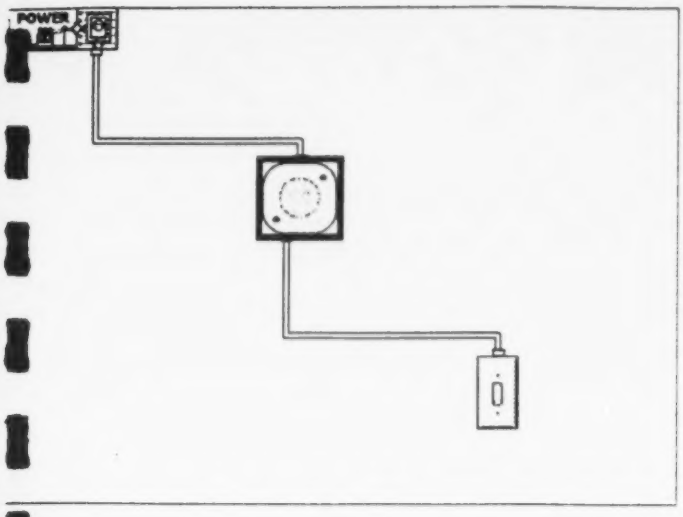
- understand moderate and advanced principles of mechanics, electricity, thermodynamics, and fluid dynamics.
- understand the operation of complex machines and systems, such as gasoline engines, complex appliances, and building electrical systems.

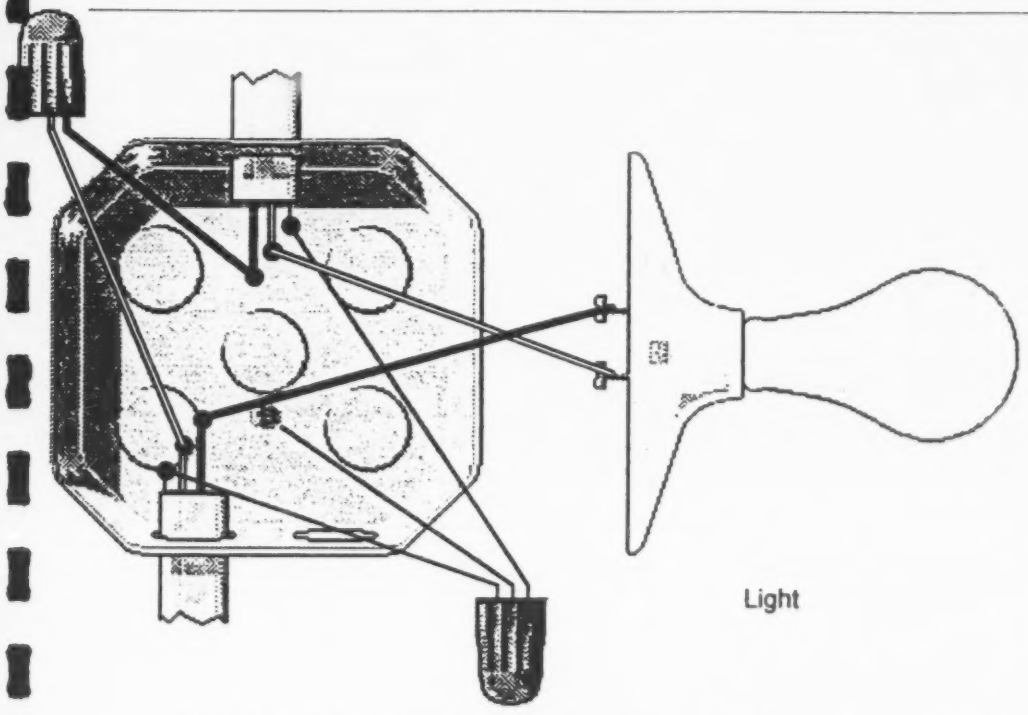
Appendix B:

Sample Wiring Diagram and Assignments



Key: 2-Conductor
3-Conductor





Light

Box Size: 17.5 cu. in., Metal Box Type: 2" x 2-1/8" Round, Plastic Box Type: 4" Round

Black
Red
White
Ground

Circuit diagrams demonstrate the basic switching and branching in household lights, switches and receptacles. They do not account for load – the amount of power used.

The Simulator does not check for unused, bare wires in a box. Always remove them or cap them with wire connectors in wiring your own circuitry.

Diagrams in this program depict grounding for metal boxes with non-metallic cable. Plastic boxes do not require a ground to the box. Metal conduit systems require a ground from the box to all devices.

Plastic boxes are not permitted for use with armored cable or conduit.

Red wire (longest wire emerging from cable) may print as white or black on some printers. Please trace its

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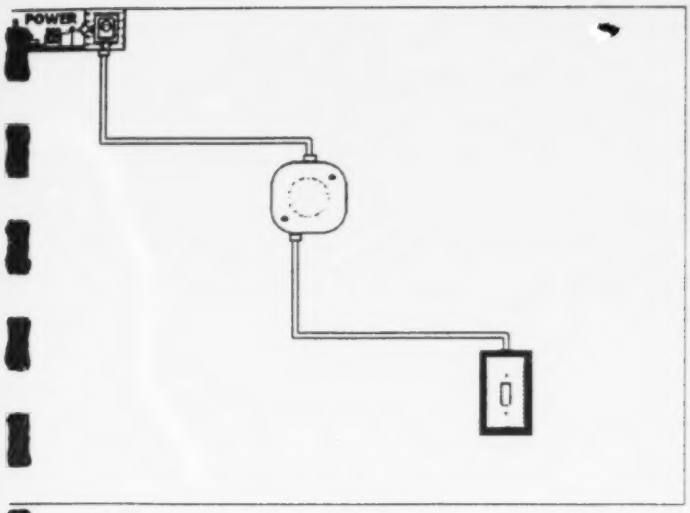

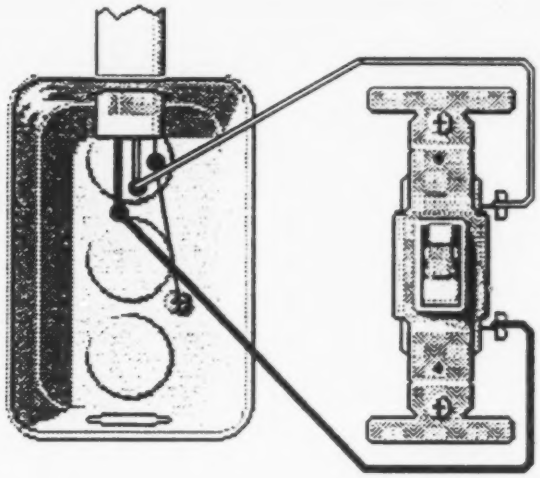

Single-pole switch

Box Size: 12.5 cu. in., Metal Box Type: 3" x 2" x 2-1/2" Device, Plastic Box Type: 18 cu. in. Device

: Black
Red
White
Ground

Circuit diagrams demonstrate the basic switching and branching in household lights, switches and receptacles. They do not account for load – the amount of power used.

The Simulator does not check for unused, bare wires in a box. Always remove them or cap them with wire connectors in wiring your own circuitry.

Diagrams in this program depict grounding for metal boxes with non-metallic cable. Plastic boxes do not require a ground to the box. Metal conduit systems require a ground from the box to all devices.

Plastic boxes are not permitted for use with armored cable or conduit.

Red wire (longest wire emerging from cable) may print as white or black on some printers. Please trace its

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ELE 115

Low Voltage Circuits

Projects

Student Name

Written by
Larry G. Blevins

Revised
January 18, 1994
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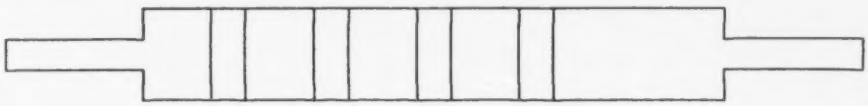
Project Completion Sheet (1)

Student Name _____

Project		Completion
1.	Multimeter test in a series circuit.	_____
2.	Multimeter test in a parallel circuit.	_____
3.	Electrical splices.	_____
4.	Test resistors using an ohmmeter.	_____
5.	Test capacitors using an ohmmeter.	_____
6.	Test low voltage double pole relay using an ohmmeter.	_____
7.	Test a diode using an ohmmeter.	_____
8.	Test a full-wave bridge rectifier using an ohmmeter.	_____
9.	Test transistors using an ohmmeter.	_____
10.	Connect a door bell that is controlled from one location.	_____
11.	Connect a door bell that is controlled from two locations.	_____
12.	Connect a bell and a buzzer using only three conductor between each location.	_____
13.	Connect a single light from one location using a low voltage lighting relay.	_____
14.	Connect a single light from two locations using a low voltage lighting relay.	_____
15.	Connect a three station annunciator controlling a bell, buzzer, and light.	_____
16.	Connect a low voltage AC plug in relay	

4. Testing resistors using an ohmmeter. Write the colors in the appropriate bars and color in with the proper colors. Identify the size of resistors using the resistor color code. Measure the value using an ohmmeter and indicate the tolerance for each resistor. Place each reading in the space provided.

A. First resistor



(1) What is the resistor value determined by the color bands?

_____ Ohms

(2) What is the resistor tolerance value?

_____ Percent

(3) What is the high value that the resistor may read and still be good?

_____ Ohms

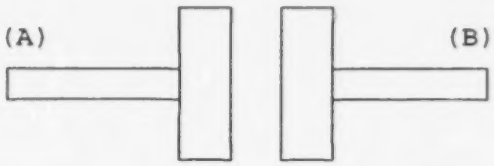
(4) What is the low value that the resistor may read and still be good?

_____ Ohms

(5) What is the measured value read using an Ohmmeter?

_____ Ohms

5. Testing a capacitor using an Ohmmeter.
In the truth table shown below, place a (+) or (-) under either column A or column B to indicate the polarity of the ohmmeter connected to test the capacitor. Place a check mark indicating the meter reading under the column for infinity or continuity for each condition.



	A	B	INFINITY	CONTINUITY
1				
2				
3				
4				

ELE 105
Introduction to Electricity

Task Sheet Two
Conduit/Conductors/Ampacity

Task: Using the National Electrical Code Book and demonstration boards determine the proper number of conductors permitted to be installed in conduit systems and evaluate the load ampacity for each scenario.

Procedure:

1. Use demonstration board number one (1) and consider the following information.
   - A. Identify the size of the conduit.
   - B. Assume that the length of conduit is 75 feet.
   - C. Determine the number of conductors installed in the conduit.
   - D. Determine the AWG size for each conductor installed in the conduit.
   - E. Calculate the maximum load permitted on each conductor assuming an ambient temperature of 90° F.
   - F. Using the smallest conductor presently installed in the conduit system calculate the maximum number of conductors permitted in the conduit if all wires are the same.
2. Use demonstration board number two (2) and consider the following information.
   - A. Identify the size of the conduit.
   - B. Assume that the length of conduit is 150 feet.
   - C. Determine the number of conductors installed in the conduit.
   - D. Determine the AWG size for each conductor installed in the conduit.
   - E. Calculate the maximum load permitted on each conductor assuming an ambient temperature of 105 ° F.
   - F. Using the smallest conductor presently installed in the conduit system calculate the maximum number of conductors permitted in the conduit if all wires are the same.
3. Use demonstration board number two (3) and consider the following information.
   - A. Identify the size of the conduit.
   - B. Assume that the length of conduit is 15 inches.
   - C. Determine the number of conductors installed in the conduit.
   - D. Determine the AWG size for each conductor installed in the conduit.
   - E. Calculate the maximum load permitted on each conductor assuming an ambient temperature of 100 ° F.
   - F. Using the smallest conductor presently installed in the conduit system calculate the maximum number of conductors permitted in the conduit if all wires are the same.

ELE 105
Introduction to Electricity

Task Sheet Three
Number of conductors in boxes

==========

Task: Using the National Electrical Code Book determine the proper number of conductors permitted to be installed in three typical boxes used in electrical construction.

Procedure:

1. Consider the following circuit when determining the number of conductors allowed in each box.

   A. Power is fed from a service panel to a metal octagon box using 14/2 NM cable.
   B. A 14/3 NM cable is routed from the metal octagon box, containing a keyless light fixture, to the metal sectional box containing a single pole switch.
   C. A 14/2 NM cable is routed from the metal sectional box, containing a single pole switch, to a plastic device box containing one duplex outlet.

2. Go to the Material Storage Room and procure three of the boxes listed.

   A. Metal octagon box
   B. Metal sectional box
   C. Plastic device box

3. Determine the maximum number of conductors permitted in a metal octagon box using the following conditions:

   A. Box contains one keyless light fixture.
   B. NM 14/2 enters the box.
   C. NM 14/3 enters the box.

      (1). Is the metal octagon box adequate for the stated conditions?

      (2). What is the smallest octagon box permitted?

4. Determine the maximum number of conductors permitted in a metal sectional box using the following conditions:

   A. Box contains one single pole switch.
   B. NM 14/3 enters the box.
   C. NM 14/2 enters the box.

      (1). Is the metal sectional box adequate for the stated conditions?

      (2). What is the smallest sectional box permitted?

5. Determine the maximum number of conductors permitted in a plastic device box using the following conditions:

   A. Box contains one duplex outlet.
   B. NM 14/2 enters the box.

      (1). Is the plastic device box adequate for the stated conditions?

      (2). What is the smallest plastic device box permitted?

ELE 105
Introduction to Electricity

Task Sheet Four
Switches/Receptacles

Task: Using an electrical trade catalog and demonstration boards determine the characteristics and description for each of the devices shown.

Procedure:

1. Use demonstration board number one (1) and consider the following information.

   A. Identify the type of receptacles shown.

   B. List the individual characteristics for each receptacle.

   C. Determine the size of circuit breaker permitted to supply each receptacle.

   D. Determine the size of conductor permitted to supply each receptacle.

   E. Identify the amount of load permitted for each receptacle.

2. Use demonstration board number two (2) and consider the following information.

   A. Identify the type of switches shown.

   B. List the individual characteristics for each switch.

   C. Determine the size of circuit breaker permitted to supply each switch.

   D. Determine the size of conductor permitted to supply each switch.

   E. Identify the amount of load permitted for each switch.

ELE 105
Introduction to Electricity

Task Sheet Five
Tools

Task: Using textbook, House Wiring Simplified and an electrical trade catalog, you are to identify the tools contained in a tool box.

Procedure:

A. Go to the toolroom and check out the tool identification box.

B. Identify the following tools by the number given in the tool identification box.

(1). Side cutting pliers

(2). Diagonal cutting pliers

(3). Needle nose pliers

(4). Adjustable pliers (channel locks)

(5). Phillips head screwdriver

(6). Standard screwdriver

(7). Four way screwdriver

(8). Holding screwdriver

(9). Chalk box or chalk line

(10). Plumb bob

(11). Hacksaw

(12). Keyhole saw

(13). Chisel

(14). Level

(15). Safety glasses

(16). Scratch awl

(17). Center punch

ELE 116
General Electrical Wiring
Writing Exercise
Computer Assignment One
Get Wired

Write one question for each topic from the six chapters for the computer program Get Wired. Follow the guidelines listed below.

1. Print or type one multiple choice question for each topic from the six chapters of the computer program Get Wired..

   A. Multiple choice questions will contain at least four reasonable alternative answers.
   B. A maximum of fifteen percent of the total questions may be written as true/false.

2. A heading will be printed or typed identifying the chapter from which each question is written.

   A. Your name and course number and date will be placed on a test cover sheet.
   B. Each question shall be identified by the topic shown in each chapter.
   C. The correct answer will be identified by circling the proper response.
   D. The questions will be submitted for evaluation in the same order as the chapters and topics listed in the computer textbook.

3. The questions will be typed or printed on standard 8 1/2" x 11" paper and secured by a staple in the top left hand edge.

4. Evaluation will be based upon the following standards:

   A. Following procedures (35 points).

      (1). Size paper
      (2). Cover sheet
      (3). Printed or typed
      (4). Correct order of questions
      (5). Chapter and topic identified
      (6). Number of alternative answers
      (7). Papers secured using a staple.

   B. Correct number of questions (15 points).

      (1). Number of questions
      (2). Number of true/false questions
      (3). Number of multiple choice questions

   C. Questions written using correct sentence structure (40 points).

      (1). Correct spelling
      (2). Answers identified
      (3). Complete sentences
      (4). Answers that are plausible

   D. Professional quality (10 points).

      (1). Neatness and readability
      (2). Technical difficulty of sentence

ELE 116
General Electrical Wiring

Computer Assignment Two
Get Wired

Using the computer program Get Wired, use the simulator section to develop wiring diagrams of the projects identified in your ELE 116 Project Book. Only the 120 volt, 15 and 20 ampere lighting and outlet circuits are to be completed on the computer prior to performing hands on wiring in the lab area.

1. Complete a wiring diagram for each of the wiring projects in your Project Book using the computer.

   A. The cable diagrams for each project must be followed.

      (1). Be careful to bring the cables into the boxes in the manner that you will wire each project.

         (a). Example: Wiring to switches will have the cables entering the top of switches.

2. Use the Get Wired simulator to test your circuit.

3. Print your circuits and place in a three ring note book in the order that corresponds to the Project book.

   A. Use tabs to identify each project by number.

4. Have your work checked by your instructor.

ELE 116
General Electrical Wiring

Computer Assignment Three
Computer Estimating

Task: Using the National Electrical Code Book and Electrical Estimating computer program perform electrical estimates, both for time and materials for the hands on lab projects.

The instructor will identify a specific lab project that you will use to perform your electrical estimate.

Procedure:

1. Review the lab projects identified in the Electrical Projects Booklet.

   A. Wiring will conform to minimum code standards and will be wired in the manner shown on the cable layout drawing.

2. Review the detail drawing showing exact placement of boxes, devices, and equipment.

3. Perform a take-off, identifying all materials and equipment to be installed.

   A. Use plastic boxes where permitted, ceiling boxes shall be metal boxes with cable or Romex straps.

4. Input data collected using the computer estimating program.

   A. Tabulate the an estimate based upon each project identified in the Electrical Projects Booklet.

5. Determine the total material to be used and a perform a cost estimate for the total of all projects.

6. Compare the estimated cost determined by the computer estimating program to the actual cost for the completed projects.

   A. Use a local electrical suppliers catalog for the comparison.

7. Compare a time labor study of work actually done to the estimated time performed in wiring the projects.

Appendix C:

"Electrical Construction Operations" Report

ELECTRICAL CONSTRUCTION OCCUPATIONS

Interim Job Descriptions and KSA Lists for

Electrical Construction Worker

Electrical Line Construction Worker

Electrical Residential Construction Worker

U.S. ELECTRICAL CONSTRUCTION INDUSTRY SKILL STANDARDS & CERTIFICATION PROJECT

January 1995

This is an interim document produced by the U. S. Electrical Construction Industry Skill Standards and Certification Project (using the acronym ECSSP for Electrical Construction Skill Standards Project) as a part of its ongoing skill standards development process. These are not skill standards themselves, but represent a compilation of the information gathered by the project through review of the literature, on-site observation, expert panel input, and job analysis surveys of job incumbents and training personnel.

This document is not considered to be a final document and is subject to revision.

It is provided for information/comment purposes only.

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U.S. ELECTRICAL CONSTRUCTION INDUSTRY
SKILL STANDARDS AND CERTIFICATION PROJECT

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ELECTRICAL RESIDENTIAL CONSTRUCTION WORKER

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DEFINITION OF FREQUENCY: When used in this report, the term "Daily" means one or more times each day; "Weekly" means one or more times each week; "Monthly" means one or more times each month; "Occasionally" means less often than once per month. Frequency should not be confused with importance. A particular job duty or activity may be critical to the successful completion of a project, but performed only a few times a year. Highly important activities have been identified with an asterisk (*).

ELECTRICAL CONSTRUCTION OCCUPATIONS

U.S. ELECTRICAL CONSTRUCTION INDUSTRY SKILL STANDARDS AND CERTIFICATION PROJECT

OVERVIEW

This document has been prepared by the Technical Committee of the U.S. Electrical Construction Industry Skill Standards and Certification Project. The Project is a cooperative agreement between the Labor Department and a coalition of organizations representing the electrical construction industry.

Late in 1992, the U.S. Department of Labor solicited bids from interested groups to develop voluntary, industry-based skills standards for their industry. In view of the long history and large investment in the development of standards and training of electrical workers by organizations within the electrical construction industry, the U.S. Electrical Construction Industry Skills Standards and Certification Project was organized and responded to this solicitation proposing to draft skill standards for the "electrical construction worker" occupation. Now using the acronym ECSSP (for Electrical Construction Skill Standards Project) the coalition of industry groups was awarded a grant as one of six national organizations to take part in the Labor Department's pilot program to develop and implement voluntary standards. (The Department of Education has awarded additional grants in a similar pilot program.)

THE COALITION

ECSSP's proposal called for the formation of an industry coalition comprised of national trade associations representing electrical contractors, individual union and nonunion electrical contractors, representatives of electrical workers, representatives of electrician training programs, federal and state governments, educational groups and other interested parties. Run by a Management Committee elected from this constituency, the project set about to assess the current status of electrical industry skills standards and to draft a new set of skills standards for the "electrical construction worker."

THE PROCESS

The original project design established four regional committees covering the Eastern, Midwestern, Southern and Western regions of the country. Their initial duty was to gather information about the standards being used by organizations other than those represented by the coalition members to train electrical workers and pass it on to the management committee which is charged with actually preparing the final standards. The regional committees should allow the project to develop more local level information than would be possible from the national level.

During the initial year, a nationwide job analysis study was begun. To develop the job analyses, written materials about the jobs were reviewed. Personal observation of and interviews with journeymen and apprentices were conducted at several work sites. A job analysis survey was constructed based upon the information gained in these first steps. Large groups of instructors and training directors were convened to link the job tasks to the knowledge, skills and abilities needed to perform those tasks. Training directors and instructors were surveyed regarding their perceptions about the positions. Finally, thousands of surveys were mailed to randomly selected electrical construction workers and apprentices to collect data on the task analysis portion of the job analysis.

The same survey document was sent in separate mailings to two groups. The first group consisted of job incumbents, training personnel and contractors affiliated with the organized sector of the industry and the second group consisted of job incumbents, training personnel and contractors affiliated with the open shop sector of the industry.

SCOPE AND OCCUPATIONS EXPANDED

During the development of the job analyses it was also decided that the occupations subject to review by the project be expanded. In the early phases of the studies (literature review, on-site observation, expert panel review) the traditional view of the industry as supporting three well defined occupations electrical construction worker [inside, building construction], electrical line construction worker [outside, powerline construction], and electrical residential construction worker [residential, home building]) was confirmed. *(The occupational titles used in this document are, like the document itself, interim titles and subject to revision.)* Therefore, the project decided to draft standards for all three rather than just the original occupation -- electrical construction worker.

The survey questionnaires have been completed and returned. The responses to each survey were tabulated separately by two independent consultants. The results of the two surveys were then compared and found to be in virtually complete agreement. They were then compiled by a technical committee into this document.

The technical committee has begun to draft the skills standards from this information.

The project has been awarded an extension period in order to complete its work. During the extension period, draft standards will be completed and distributed to the management and regional committees for review and comment in the spring. During this review process, the regional committees should conduct open meetings to allow input from other interested persons and organizations. Following review, final standards will be developed and disseminated to all interested parties in the summer of 1995.

In addition to the standards, the project will also be looking at related areas, such as instruction delivery methods, curriculum models and certification/accreditation issues.

Because the initial U.S. Department of Labor solicitations for voluntary, industry-based standards were directed at national trade associations, the project was organized by the National Electrical Contractors Association, and originally authorized by the U.S. DOL as the USDOL/NECA Skill Standards and Certification Project. To better reflect the broad industry basis for the project, the management committee has changed the project's name to the U.S. Electrical Construction Industry Skill Standards and Certification Project, using the acronym ECSSP (for Electrical Construction Skill Standards Project).

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JOB DESCRIPTION FOR ELECTRICAL CONSTRUCTION WORKER (ECW)
(Inside, Building Construction)

The duties of an ECW are listed below. Tasks are described as *daily, weekly, monthly or occasionally*, based upon the responses of a majority of ECW in the position. Tasks that were rated *highly important* have an asterisk.

I. PLANNING AND INITIATING PROJECT

Daily — When planning a new project, an ECW must study blueprints and specifications.* Materials, supplies and equipment must be ordered to complete the job.*

Weekly — Materials and supplies must be loaded, hauled and unloaded at the job site. The ECW establishes work areas and assembles tools and equipment. The ECW coordinates tool requirements with the contractor. The job schedule must also be coordinated with other crafts.*

Monthly — At times the ECW establishes timetables and/or progress charts for completion of the work. It may be necessary to obtain clearances, such as for digging.*

Occasionally — An ECW may be required to set up a temporary construction trailer or other control center at the site.

II. ESTABLISHING TEMPORARY POWER DURING CONSTRUCTION

Monthly — An ECW may need to maintain and repair a temporary power system as needed during construction.

Occasionally — An ECW may determine temporary power requirements by consulting with other crafts. Temporary power needs may need to be coordinated with a local power company. The ECW may need to establish a temporary power source, set up temporary panel(s), and run lines for temporary power and lighting throughout the project.

III. ESTABLISHING GROUNDING SYSTEM

Monthly — The ECW positions the ground conductors and welds or mechanically connects them.

Occasionally — An ECW studies blueprints to determine a plan for the grounding system.* The location of the grounding conductors and connections must be laid out first.* Next, the ECW digs trenches or coordinates trench excavation performed by others. After the electrodes or rods are established, the system can be tested.* If the system is working properly, the area is backfilled with dirt.

IV. INSTALLING SERVICE TO BUILDINGS AND OTHER STRUCTURES

Monthly

The ECW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be secured, reinforced and the inside swabbed, if needed. The location of the conduit stubups may be measured and determined.*

Occasionally

An ECW studies blueprints to determine where power will feed from the substation.* The local power company may need to be contacted to determine the location of feeders.* The location of other electrical conduit or other structures, such as water mains, must be determined before deciding where to locate the new feeders.* The ECW may need to compute the size of service entrance conductors needed for the required service.*

When the locations of the feeders are determined, the ECW lays out trenches for the conduit. The ECW digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ECW then backfills the trench with dirt or other materials. An overhead service entrance may also be established.

V. ESTABLISHING POWER DISTRIBUTION WITHIN PROJECT

Monthly

The ECW makes all necessary terminations.*

Occasionally

An ECW studies blueprints to determine the location of the high voltage room or electrical closet.* The transformer equipment, including transformers, breakers and switching gear, may need to be moved into the building. Once in the building, the equipment must be moved from the entry points to the correct position. The ECW may install the main service panel, including the circuit breakers and switching gear, and hipots the high voltage cables.* If needed, a buss duct may be placed to carry power.

VI. PLANNING AND INSTALLING RACEWAY SYSTEMS

Daily

An ECW must calculate the necessary bends, saddles and offsets needed to install conduit. the ECW must determine where to place the junction boxes.* He or she measures where the conduit should land and the amount of conduit needed to complete the run. In preparing the conduit for use, the ECW must cut it to fit, file or ream the inside to make it smooth, and then bend it and thread it.* After it is prepared, the conduit must then be transported to the correct location. The conduit can be connected by screwing pieces together or using couplings. The ECW plumbs and levels the conduit and places the junction boxes where planned, making holes if needed and making sure the box is plumb and level.

Weekly

An ECW studies blueprints to determine the placement of the conduit.* The number of wires/cables that can be put into each conduit must be determined.* Sometimes holes must be cut in metal to run the conduit. Hangars and support for conduit must sometimes be built. When completed, the cables may be marked and/or tagged for voltage and other identification.

Monthly An ECW may be required to cut holes in concrete to run conduit.

Occasionally An ECW may sometimes paint the conduit for identification.

VII. INSTALLING NEW WIRING AND REPAIRING OLD WIRING

Weekly An ECW assembles all materials needed at the location for pulling the cable. Small conduit can be fished with fish tape or other means. A string line must first be pulled through the conduit followed by a rope. The length of wire needed is measured with the pull line or a calibrated tape. The ECW cuts the length of wire or cable needed.* The rope is pulled through the conduit connected to a pull line. The ECW sets up wire/cable reels for pulling. The wire is connected to the pull line and lubricated to facilitate pulling. The ECW pulls the wire by hand. After the wire is pulled, the necessary terminations are made and the wire is spliced if needed.* An ECW may examine and test existing wire.

Monthly An ECW may be required to pull wire with a pulling machine. An ECW may swab the inside of large conduit to remove dirt or debris before pulling the wire.

VIII. PROVIDING POWER AND CONTROLS TO MOTORS, HVAC, AND OTHER EQUIPMENT

Monthly An ECW studies blueprints to determine where motors and equipment will be placed and establishes the layout.* The power feed and control wiring system must be installed.* The motor must be connected to run on the appropriate voltages.* The ECW may need to change the direction of rotation of electrical motors. After installation, the ECW tests the functioning of the motors.

Occasionally An ECW must read the technical manuals describing the functioning of each piece of equipment in order to determine the proper connection.* A control panel may need to be constructed or installed for the motors and equipment. The ECW may set the motors in place and secure it with bolts or other equipment. Various starters may be installed, including starters for DC motors, magnetic starters, potential-type motor starters, and reduced voltage starters. The ECW may locate and connect pilot/control devices for the motor and/or electronic variable speed motor controls. The motor must be connected to run at the appropriate speed.*

IX. INSTALLING RECEPTACLES, LIGHTING SYSTEMS, AND FIXTURES

Weekly An ECW studies blueprints to identify circuits.* At times it may be necessary to work around other systems, such as air conditioning, to find a path for lighting and receptacle wiring. The ECW locates raceways for carrying the wire. The ECW measures the wire needed for various runs. He or she then establishes homeruns from the panel box. The ECW must run raceway, cable or wire from the junction box to the lighting fixture. The ECW makes electrical connections in the fixtures and receptacles and places lamps in the lighting fixture. Switches must be located to control lighting

and receptacles must be installed for power outlets. Plates and covers must be placed on the receptacles and switches. The ECW may attached a lighting fixture to the ceiling. After installation, the ECW tests the lights and receptacles.

Monthly An ECW may need to balance loads on various circuits.* Other crafts may need to be consulted before making the final determination of locations for lighting systems. The ECW may need to establish panel boxes. When installing fixtures, it may be necessary to cut openings in the ceiling.

Occasionally An ECW may make a panel directory. After the work is complete, the ECW may complete "as built" drawings.

X. TROUBLESHOOTING AND REPAIRING ELECTRICAL SYSTEMS

Monthly An ECW determines which lighting fixture or piece of equipment is not working properly.* Possible reasons for failure can be reviewed. He or she may discuss the problem with an operator or other witnesses. The problem is analyzed through testing.* The faulty unit or component is localized. The ECW then replaces or repairs the faulty component.

Occasionally The faulty section of a circuit may be identified using the split-half method.

XI. INSTALLING AND REPAIRING TRAFFIC SIGNALS, OUTDOOR LIGHTING, AND OUTDOOR POWER FEEDERS

Occasionally When installing outdoor lighting and signals, the ECW must follow blueprints that show where equipment is to be located.* An ECW lays out trenches for the conduit. The ECW digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ECW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be secured, reinforced and the inside swabbed, if needed. The ECW lays direct burial cable without the conduit. A hole must be dug for the lighting base. An ECW may form the base for the pole, including assembly of reinforcing steel. The base may then be poured with concrete and finished. A ground rod may be driven, if required, and a ground conductor installed. The ground connection may then be welded or clamped together. When the base is finished, it may be backfilled and compacted.

The ECW may assemble poles and other hardware, as well as the lighting fixture or traffic light. After the fixture is attached to the pole, the pole can be set and leveled. The pole is set and then attached with anchor bolts, Cable can be pulled and terminated. Direct burial cable may need to be spliced.

For traffic signals, the ECW must cut sensor loops in the asphalt and place sensors in the road. Control cabinets must be established and the traffic or signal controller programmed. After installation is complete, power can be connected and tested.

XII. INSTALLING FIRE ALARM SYSTEMS

Occasionally The ECW studies blueprints to determine fire alarm device locations* and reads the manual on the specific fire alarm system being installed.* The detection and signal devices must be placed and a connection made between these devices and the controller. The ECW installs raceways and control panels for the alarm system, as well as manual pull alarm stations. Programmable alarm systems must also be programmed according to requirements.* After installation, the system must be tested to be sure that it is working properly.* The ECW then can schedule a test and inspection by state and/or local authorities.

XIII. SUPERVISING ECW AND APPRENTICES

Daily On a daily basis, an ECW assigns tasks to personnel, including apprentices.* The ECW may need to teach an apprentice a new task by explaining or demonstrating.* The apprentice's performance must then be observed and feedback given.*

Weekly At least once a week, tasks must be reviewed to determine personnel scheduling.* An ECW is required to supervise worker performance and provide feedback.*

The following duties are an important part of the work of an ECW, but are not performed as frequently as those duties already described.

XIV. ESTABLISHING OSHA AND CUSTOMER SAFETY REQUIREMENTS

Daily On a daily basis, an ECW must use proper tools and equipment in order to perform work safely.*

Weekly Job-site safety meetings are conducted at least once a week. The ECW must inspect and maintain personal protective equipment.*

Monthly An ECW must review applicable OSHA safety standards and customer safety requirements. These are used to develop an on-site safety program.* Sometimes the ECW must use protective devices when working with live conductors.* An ECW may need to check materials data safety sheets for materials used on the job.

Occasionally An ECW may need to keep the public away from the working area. A traffic control plan may need to be set up and maintained. At times, an ECW is required to administer first aid to an injured victim.* The ECW may need to perform an emergency rescue* or administer CPR to a victim.*

The following duties are also an important part of the work of an ECW, but are performed only occasionally. The activities listed under each duty are generally performed each time the duty is required.

XV. INSTALLING INSTRUMENTATION AND PROCESS CONTROL SYSTEMS, INCLUDING ENERGY MANAGEMENT SYSTEMS

When installing an instrumentation or process control system, the ECW studies the blueprints and schematic diagrams for the system* and reads the manual on the system.* The layout for various devices must be determined, including temperature, lighting, pressure-sensitive, level, flow measuring, or chemical sensors.* The ECW locates the instrumentation devices and builds raceways to hold the cables. Control panels must be installed, as well as conductors and tubing. The ECW makes the electrical or pneumatic connections between the sensors and the controller.

A central processing unit may need to be established. The ECW programs the computer or other programmable control devices.* The instruments must be tested and calibrated.* The ECW performs a loop check and prepares loop sheets documenting the system as installed.

XVI. ERECTING AND ASSEMBLING POWER GENERATION EQUIPMENT

The ECW may install batteries to provide a backup power source. The batteries may be installed in series or in parallel. At times, an ECW may be required to assemble a generator. The generator may then be installed and tested to be sure it is operating properly.*

XVII. INSTALLING SECURITY SYSTEMS

The ECW studies blueprints to determine the locations of security system components* and reads the manual on the specific security system being installed.* A control panel for the system must be located and installed. The initiating and detection devices must be positioned. The ECW establishes raceways and wires for the alarm system. Video equipment, including cameras and other monitors, may be positioned. Doors and windows may be wired to detect opening and closing. Motion detectors may also be placed and connected. The ECW programs and tests the security codes for the system. The system is tested and adjusted to be sure it is operating as planned. He or she distributes access codes to the appropriate persons. Building personnel may need to be trained on the use of the system.

XVIII. INSTALLING, MAINTAINING AND REPAIRING LIGHTNING PROTECTION SYSTEMS

An ECW determines the layout of the lightning protection system. Rods are driven and tested, if required. Conductors are established between the grounded structures, and the rods are bolted or welded together. Cable can be laid on the roof deck and fastened to the deck and walls. Any exposed cable is sealed by the ECW. Rods or points with brackets are mounted and connected to the grounding cable.

XIX. INSTALLING AND REPAIRING TELEPHONE AND DATA SYSTEMS

An ECW may need to design a new telephone or data system while keeping the old system operational. The ECW works with the customer to determine their requirements. The installation manual for a computer control system may need to be read and applied. The ECW may need to consult with the company about the specific application being used. The telephone, data control panel, and/or distribution frame may be built by the ECW. Cable trays may need to be positioned to hold the wires. The ECW may install jacks, patch panels, telephone, data system hubs and devices, and telephone and data switchplates consistent with system design. Fiber optic, coaxial and/or twisted pair cable can be pulled to individual work stations throughout the building. The wires can be terminated in the control panel or central processing unit. Fiber optic cable may need to be spliced and terminated.* Wires are tagged to mach the intended system. The ECW programs the telephone control computer to handle the phone service as planned. The completed system can be tested using special test equipment. The fiber optic cable may be tested and certified.* If errors appear upon testing, the system must be adjusted and then retested.*

USE OF TOOLS

ECW use a broad array of tools. Using the same procedure as above, we classified tools by frequency in the same manner.

Daily

Hand Tools: level, pliers, needle nose pliers, slip joint pliers, hammer, wire cutters, screwdriver, fishtape, measuring tape, hacksaw, wire stripper, hand bender, ladder, knife, ruler, wrench, knock-out sets

Power assisted tools: hand drill

Meters: voltmeter

Weekly

Hand Tools: file, punch, socket set, allen wrench, keyhole saw, crimping tool, hand drill, hand reamer, awl, vise, tap and dies

Power assisted tools: electric screw gun, electric roto hammer drill, hydraulic bender, power cutting and threading machine

Meters: ammeter

Monthly

Hand tools: plumb bob, fuse puller, clamps, pipe wrench, torque wrench, architect scale, handsaw, wood chisel, shovel, hoist cum-a-long

Power assisted tools: electric saber saw, wire tugger

Heavy equipment: electric lift

Occasionally

Hand tools: transit, block and tackle, adapter cables, caliper, tamp tool

Power assisted tools: soldering iron, drill press, gas-operated auger, air hammer, concrete coring machine, roto stripper, water pump, fiber optic fusion splicer

Meters: oscilloscope, wattmeter, optical power meter, MEGGER, dielectric test set to hipot cable, dynamometer, optical time domain reflectometer (OTDR)

Heavy equipment: trencher, bucket truck, crane, power borer, derrick, auger, dozer, backhoe, caterpillar

ELECTRICAL CONSTRUCTION WORKER
(Inside, Building Construction)

IMPORTANCE RANKINGS OF KNOWLEDGES

Knowledges are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The knowledges are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Knowledge of National Electrical Code
Knowledge of blueprints, including symbols used
Knowledge of state and local electrical codes
Knowledge of schematic electrical diagrams
Knowledge of how to work with energized circuits
Knowledge of specific job safety rules
Knowledge of hazardous materials
Knowledge of first aid
Knowledge of OSHA requirements
Knowledge of the principles of grounding
Knowledge of different conduit bends (saddle, offset, etc.)
Knowledge of connections to be made for various transformers
Knowledge of Ohm's Law and related formulas
Knowledge of proper overcurrent protection for transformers
Knowledge of which wire/cable to use in different circumstances
Knowledge of delta and wye transformer connections
Knowledge of which materials are good conductors and insulators
Knowledge of direct and alternating current
Knowledge of how to calculate degrees when bending conduit
Knowledge of building specifications
Knowledge of how to perform an emergency rescue
Knowledge of parallel circuits
Knowledge of magnetic motor controls
Knowledge of circuit breaker ratings
Knowledge of transformer ratings
Knowledge of fuse ratings
Knowledge of combination circuits
Knowledge of series circuits
Knowledge of how to care for tools and equipment
Knowledge of solid state motor controls
Knowledge of fire alarm systems
Knowledge of how fuses operate
Knowledge of switching procedures
Knowledge of ladder logic diagrams
Knowledge of how AC motors operate
Knowledge of the ratings of different types of switch gear
Knowledge of resistance and its effects
Knowledge of the properties of high-voltage cable
Knowledge of appropriate hand signals to use with ground crew or equipment operators
Knowledge of how a circuit breaker works
Knowledge of inductance

VERY TO MODERATELY IMPORTANT

Knowledge of how generators/alternators work
Knowledge of algebra
Knowledge of how DC motors operate
Knowledge of how a surge protector or lightning protector works
Knowledge of the functions of capacitors
Knowledge of which knot to tie in different circumstances
Knowledge of power factor correction
Knowledge of other crafts' scope of work and responsibilities
Knowledge of the functions of batteries in providing electrical power
Knowledge of programmable logic controllers
Knowledge of how transformers are constructed
Knowledge of how to erect a pulley system for lifting heavy objects
Knowledge of how a voltage regulator works
Knowledge of photo-electric sensors
Knowledge of security systems
Knowledge of sine waves generated by electrical power
Knowledge of process controllers and control loops
Knowledge of geometry
Knowledge of air conditioning and environmental control systems
Knowledge of harmonic distortion of voltage/current
Knowledge of the spacing of ducts needed in a duct bank
Knowledge of the lifting capacity of various riggings for block and tackles
Knowledge of temperature sensors
Knowledge of pressure sensitive sensors
Knowledge of the properties of fiber optic cable
Knowledge of level sensors
Knowledge of the effect of soil conditions on underground cable
Knowledge of the properties of twisted pair cable
Knowledge of proper depth and width needed when digging holes for supporting poles
Knowledge of the properties of coaxial cable
Knowledge of telephone and data systems
Knowledge of the properties and use of insulating oils in transformers
Knowledge of semiconductor electronics
Knowledge of chemical sensors
Knowledge of trigonometry

MODERATELY TO SOMEWHAT IMPORTANT

Knowledge of what makes a wooden pole unsafe to climb
Knowledge of local area networks
Knowledge of strains and loads on a pole or tower that could require a guy wire
Knowledge of the properties of metal, concrete or fiberglass poles and towers
Knowledge of which ties to use with which types of insulators
Knowledge of how many and which kinds of insulators to use on power lines
Knowledge of orthographic and isometric sketching
Knowledge of different types of guy anchors
Knowledge of different types of pole and crossarm designs
Knowledge of the properties of different kinds of wooden poles
Knowledge of tree growth and pruning techniques

ELECTRICAL CONSTRUCTION WORKER
(Inside, Building Construction)

IMPORTANCE RANKING OF SKILLS

Skills are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The skills are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Skill at reading a wire table to determine conductor size required
Skill at performing CPR
Skill at terminating aluminum or copper cable
Skill at terminating high voltage cable
Skill at working in rubber gloves on high voltage lines
Skill at splicing aluminum or copper cable

VERY TO MODERATELY IMPORTANT

Skill at splicing high voltage cable
Skill at rigging equipment
Skill at terminating twisted pair cable
Skill at operating platform lift
Skill at splicing twisted pair cable
Skill at tying knots
Skill at terminating coaxial cable
Skill at splicing fiber optic cable
Skill at terminating fiber optic cable
Skill at programming programmable logic controllers
Skill at operating a bucket truck
Skill at soldering

MODERATELY TO SOMEWHAT IMPORTANT

Skill at driving a truck
Skill at splicing rope
Skill at welding
Skill at coiling and storing rope
Skill at shoveling or raking wet concrete
Skill at operating a crane

ELECTRICAL CONSTRUCTION WORKER
(Inside, Building Construction)

IMPORTANCE RANKING OF ABILITIES

Abilities are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The abilities are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Ability to be self-motivated, responsible, and dependable without close supervision
Ability to understand verbal instructions and warnings
Ability to work smoothly with others as a team to complete a task
Ability to add, subtract, multiply and divide and use formulas
Ability to remain calm in an emergency situation
Ability to communicate orally with others
Ability to maintain good relations with others in a work setting
Ability to hear warning signals
Ability to plan and organize tasks to meet deadlines
Ability to read complex technical documents, including manual on electrical equipment, code documents and safety rules
Ability to discriminate between colors
Ability to develop alternative solutions to a problem and choose the best alternative
Ability to maintain balance and perform construction tasks while on a ladder, platform, pole or tower
Ability to supervise and monitor the work of others
Ability to understand how an electrical or mechanical system works (such as security system or fire alarm system)
Ability to use hands and fingers to manipulate small wires and objects
Ability to communicate in writing with others
Ability to read and understand graphs, charts and diagrams
Ability to work with both hands (such as tying knots)
Ability to operate two-handed power equipment
Ability to lift objects up to 50 pounds
Ability to reach and stretch to position equipment and fixtures while maintaining balance

VERY TO MODERATELY IMPORTANT

Ability to coordinate body movements when using tools or equipment
Ability to carry objects up to 50 pounds for short distances
Ability to work at heights
Ability to climb ladders and poles up to 25 feet
Ability to traverse irregular surfaces while maintaining balance
Ability to work in extreme hot and cold temperature conditions
Ability to work outdoors in extreme weather conditions, including heat, cold and precipitation
Ability to picture the way a construction project will appear before it is finished
Ability to perform physical tasks all day without becoming overly tired
Ability to work in a noisy environment
Ability to lift objects above 50 pounds
Ability to push or pull heavy objects into position
Ability to work at depths, such as in trenches, manholes or deep vertical shafts
Ability to apply muscular force quickly to objects and equipment (such as starting a hand saw)

Ability to carry objects above 50 pounds for short distances
Ability to bend or twist the body into unusual positions while working
Ability to use muscular strength to raise and lower heavy objects on a line or pulley

MODERATELY TO SOMEWHAT IMPORTANT

Ability to walk long distances, sometimes over irregular terrain
Ability to work in unusual positions for long periods of time
Ability to resist torque of motor while maintaining balance
Ability to climb ladders and poles from 26 to 100 feet
Ability to bend to get over or under objects while working on top a pole or tower
Ability to climb poles above 100 feet

JOB DESCRIPTION FOR ELECTRICAL LINE CONSTRUCTION WORKER (ELCW)
(Powerline Construction)

The duties of an ELCW are listed below. Tasks are described as *daily, weekly, monthly or occasionally* based upon the responses of a majority of journeylevel ELCW in the position. Tasks that were rated *highly important* have an asterisk.

I. PLANNING AND INITIATING PROJECT

Daily — When planning a new project, an ELCW must study blueprints and specifications.* The ELCW establishes work areas. He or she assembles tools and equipment. Materials must be loaded, hauled and unloaded at the job site.

Weekly — Materials and supplies must be ordered to complete the job. It may be necessary to obtain clearances, such as for digging.*

Monthly — The ELCW coordinates tool requirements with the contractor and the job schedule with other crafts. At times, the ELCW establishes timetables and/or progress charts for completion of the work.

Occasionally — An ELCW may be required to set up a temporary construction trailer or other control center at the site.

II. ESTABLISHING OSHA AND CUSTOMER SAFETY REQUIREMENTS

Daily — An ELCW must use proper tools and equipment in order to perform work safely.* The ELCW must inspect and maintain personal protective equipment.* The ELCW installs protective devices when working with live conductors.* An ELCW may need to keep the public away from the working area.*

Weekly — An ELCW must review customer safety requirements in order to develop an on-site safety program.* Job site safety meetings are conducted at least once a week.* A traffic control plan may need to be set up and maintained.*

Monthly — An ELCW must review applicable OSHA safety standards.* Materials data safety sheets must be reviewed for materials used on the job.

Occasionally — At times, an ELCW is required to administer first aid to an injured victim.* The ELCW may need to perform an emergency rescue or administer CPR to a victim.*

III. SETTING OF TOWERS, POLES AND CONSTRUCTION OF OTHER DEVICES TO HOLD ELECTRICAL WIRING

Daily — An ELCW frequently digs holes for poles or towers using power equipment, such as an augur or power borer.* The pole must be set at the proper depth.* After the pole is set, the ELCW must determine if the pole is properly aligned.* If it is, the ELCW will backfill the hole with dirt and tamp the ground around the pole, The ELCW must

frequently install ground wires on poles and/or ground rods. When installing a new crossarm, the ELCW must measure and mark the correct place for drilling holes, drill the holes to place the crossarm and then place the crossarm in the correct position. The ELCW may install a brace for the crossarm, if needed.

Weekly — A pole or tower needs to be transported to the site. The pole is moved to the hole where it will be set. The ELCW must determine whether a guy wire is needed. If so, the length and location of the guy wire is determined.* The ELCW constructs the guy wire. The guy wire is secured by digging it in with a power-drive screw. A structure for a tower must frequently be assembled on the ground before being raised for installation. Before installing new equipment, an ELCW must frequently remove the old or damaged pole or crossarm.

Monthly — At times, an ELCW may need to dig a hole with a shovel or other hand tools, rather than using power equipment.

Occasionally — ELCW may need to perform a number of tasks before a pole or tower can be set or built. These include locating and staking lines for new tower construction, clearing right of way for the line, building right of way roads to the work site, building stream crossings, and/or building a landing at the site to accommodate digging and setting equipment. Sometimes an ELCW may secure the guy wire for a pole by digging in the anchor by hand.

ELCW may need to perform the following steps for preparing footings for a tower: building rebar cages for footings, prefabricating lattice footings, and building wood or metal forms for the above ground part of the concrete footer. When complete, the ELCW installs footings for the tower. The ELCW erect the tower and secure it to the footing,* pouring cement for the foundation, if needed. *Occasionally*, the ELCW must ream or drill holes that may be misaligned. *Occasionally*, the ELCW may install push poles or pole keys. ELCW may need to erect a reinforcing steel or wooden structure. A steel tower may need to be put together using a hydraulic press. When the structure is complete, the ELCW may paint the towers and/or other equipment. When a pole is set, the ELCW may roof it.

IV. ESTABLISHING WORK POSITION FOR MAINTAINING AND REPAIRING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES

Daily — Before climbing, an ELCW should inspect a pole for unsafe conditions, such as rotted places, knots, and loose steps.* The ELCW climbs poles to reach distribution or transmission lines.* A bucket truck may be used to reach the lines instead of climbing.* The ELCW sets up a hand line for tools and equipment. Grounds and insulating devices are installed on the line before beginning work.*

Weekly — In an urban area, an ELCW may need to establish a traffic control system. He or she may operate a platform to reach distribution or transmission lines. It may be necessary to float wire out with hot sticks or hot arms to establish a work area.*

Occasionally — At times, an ELCW is required to climb a metal or concrete tower to reach distribution or transmission lines. The ELCW may have to position a hook ladder to work on transmission lines.

V. STRINGING NEW WIRE OR MAINTAINING OLD WIRE

Daily An ELCW installs ground wires.

Weekly Old wire must be inspected for problems that might require new wire. Travelers or stringing blocks are put up to prepare for stringing wire.* An ELCW runs an initial rope line through the travelers or blocks. Traveling grounds must be installed, as well as truck and equipment grounds.* Insulated protective devices are positioned on energized conductors close to the new conductor being installed.* Temporary jumpers may be put on the wire in order to maintain service while working.* New wire is pulled in.* The ELCW sets the proper sage on the wire.* The wire is secured by deadening or clipping.* The ELCW splices wire, if necessary.* Permanent jumpers may be installed.*

Monthly Travelers may be secured where wire may float. The ELCW determines the length of wire pulls,* sets up pulling and tensioning devices,* and checks the tension. Communication must be established between the puller, the tensioner and others involved in pulling in new wire.*

Occasionally Guard structures may be established around roads, railroads and power lines.* The ELCW may install dampers on the wire or spacers between the conductors. The ELCW checks for low ground resistance. A "deadman" may be installed as an anchor for the transmission wire.

VI. INSTALLING AND MAINTAINING INSULATORS

Daily An ELCW inspects insulators for defects. New insulators are installed to replace old or damaged ones. The conductor is secured to the new insulator using tie wire, armor rods, and/or shoes.* An ELCW selects the appropriate insulator for the voltage.* The conductor must be removed from the insulator and secured while cleaning is being done.*

Weekly The ELCW prepares the insulator for installation by cleaning. The ELCW removes the defective insulator.

Monthly After installation, a shoe may be installed on the bottom of the insulator.

Occasionally An ELCW may wash insulators on existing lines.

VII. INSTALLING AND MAINTAINING TRANSFORMERS AND OTHER EQUIPMENT

Weekly An ELCW selects the transformer based on the proper primary and secondary voltage rating, kVA rating, polarity, and impedance.* The ELCW must also determine the correct transformer connection* and the proper fuse rating.* The ELCW drills holes in the pole or crossarm for securing the transformer. The old transformer is removed and returned to the ground. A new transformer is hoisted into position. The new transformer is installed by the ELCW.* Lightning protection devices are positioned to protect the transformer.* Disconnects are installed.*

Occasionally An ELCW may install voltage regulators, capacitors or sectionalizers.*

VIII. SUPERVISING ELCW AND APPRENTICES

Daily

On a daily basis, an ELCW assigns tasks to personnel, including apprentices.* Tasks must be reviewed to determine personnel scheduling.* An ELCW is required to supervise worker performance and provide feedback.* The ELCW may need to teach an apprentice a new task by explaining or demonstrating.* The apprentice's performance must then be observed and feedback given.*

The following duties are also an important part of the work of an ECW, but are performed only occasionally. The activities listed under each duty are generally performed each time the duty is required.

IX. INSTALLING, REPAIRING, AND MAINTAINING AN UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM

An ELCW designs the distribution layout of the underground system. Previously buried cable must be located, if present.* An ELCW builds manholes for present and future needs. An ELCW lays out trenches to hold the conduit. The ELCW must calculate the necessary bends, saddles and offsets needed to install the conduit. The conduit is cut to fit and bent to the necessary shape. The inside is filed to make it smooth and threaded, if necessary. The ELCW digs trenches for the conduit or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ELCW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit is connected by screwing pieces together or using connectors. If necessary, the conduit is swabbed to clean it. The conduit must be secured and reinforced. The ELCW pours concrete over the conduit in the trenches and backfills the trench with dirt or other materials.

Sectionalizing vaults and switches may be placed to meet load interruption needs.* Buss bars can be installed in the vault. The ELCW installs fault indicators. Transformers may be installed on a pad or below the ground. Vaults and cabinets may be rigged for cable pulls. The cable is pulled by hand or machine.* Cable is spliced, if necessary,* and the necessary terminations made.* The cable is tagged for identification* and grounded.* The ELCW may install stress cones,* pothead,* or anodes. After installation is complete, the cable must be tested and hipoted.*

If an outage occurs, the ELCW troubleshoots the system to determine the location of the problem.* A faulted cable may be located by radar, thumper or arc reflection.*

X. ASSEMBLY AND ERECTION OF SUBSTATIONS

An ELCW reads blueprints to determine plans for the substation.* The location of grounding conductors and connections must be laid out. The ELCW digs trenches for the grounding conductors or coordinates trench excavation by others. After placing the ground conductors and connections, the ELCW welds or mechanically connects the conductors.* The grounding system is tested.* If successful, the area is backfilled with dirt.

An ELCW lays out trenches for the conduit for the substation. The ELCW must calculate the necessary bends, saddles and offsets needed to install the conduit. The conduit is cut to fit and

bent to the necessary shape. The inside is filed to make it smooth and threaded, if necessary. The ELCW digs trenches for the conduit or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ELCW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit is connected by screwing pieces together or using connectors. If necessary, the conduit is swabbed to clean it. The conduit must be secured and reinforced. The ELCW pours concrete over the conduit in the trenches and backfills the trench with dirt or other materials.

Before building the substation structure, the ELCW prepares concrete footings. The steel, aluminum or wood parts to the structure are assembled and welded together. Buss bars are built as needed.* The ELCW may install a large transformer, including setting the transformer and making the necessary terminations.* Oil or gas may be added to the transformer.* Other equipment may be installed in the substation including insulators, circuit breakers,* capacitors,* circuit switches,* disconnect switches,* high voltage fuses,* and voltage regulators.* All structures must be grounded to the grounding field.* The ELCW hipots the conductors and equipment.*

When the substation is complete the ELCW grades the yard and covers it with gravel. Fences, gates and warning signs can then be established.

XI. INSTALLING, MAINTAINING AND REPAIRING TRAFFIC OR TRAIN SIGNALS AND OUTDOOR LIGHTING

When installing outdoor lighting and signals, the ELCW must follow blueprints that show where equipment is to be located.* An ELCW lays out trenches for the conduit. The ELCW digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ELCW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be secured and reinforced. A hole must be dug for the lighting base. An ELCW may form the base for the pole, including assembly of reinforcing steel. The base may then be poured with concrete and finished. When the base is finished, it may be backfilled and compacted.

The ELCW may assemble poles and other hardware, as well as the lighting fixture or traffic light. After the fixture is attached to the pole, the pole can be set and leveled. When the pole is set, it is attached with anchor bolts, Cable can then be pulled and terminated.

For traffic signals, the ELCW must cut sensor loops in the asphalt and place sensors in the road. Control cabinets must be established and the traffic or signal controller programmed.* After installation is complete, power can be connected and tested.*

XII. TREE TRIMMING

The ELCW examines the tree to be trimmed to decide how pruning will be done. The position to trim may be achieved through climbing the tree using a safety belt* or positioning the bucket truck to reach the tree. Branches are cut. The ELCW may apply paint and/or herbicides, fungicides and pesticides to protect the tree wound. After trimming is complete, the ELCW disposes of brush and branches.

USE OF TOOLS

ELCW use a broad array of tools. Using the same procedures as above, we classified tools by frequency in the same manner.

Daily

Hand tools: plumb bob, pliers, needle nose pliers, slip joint pliers, hammer, wire cutters, screw driver, measuring tape, ruler, socket set, wrench, crimping tools, hand drill, shovel, ladder, knife, tamp tool, hoist cum-a-long

Power-assisted tools: hand drill

Meters: voltmeter

Heavy equipment: bucket truck, auger

Climbing tools: gaffs, safety belt, body belt

Hot sticks: switch stick, universal "gripall" stick (shot gun)

Weekly

Hand tools: file, allen wrench, hacksaw, handsaw, block and tackle, ladder

Power-assisted tools: electric saber saw, electric roto hammer drill

Meters: ammeter

Monthly

Hand tools: level, fish tape, pipe wrench, wire stripper

Power-assisted tools: roto stripper, wire tugger

Heavy equipment: crane

Hot sticks: auxiliary arm, insulated tension link, tie stick, link stick

Occasionally

Hand tools: punch, fuse pullers, clamps, torque wrench, architect scale, keyhole saw, wood chisel, hand bender, transit, adapter cables, hand reamer, knock out sets, awl vise, caliper

Power-assisted tools: soldering iron, drill press, gas-operated auger, air hammer, coring machine to drill through concrete, hydraulic bender, power cutting and threading machine, roto stripper, water pump, electric screw gun, electric saber saw, fiber optic fusion splicer, electric roto hammer drill

Meters: oscilloscope, wattmeter, optical power meter, MEGGER, dielectric test set to hipot cable, dynamometer, optical time-domain reflectometers

Heavy equipment: trencher, electric lift, power borer, derrick, dozer, back hoe, caterpillar

Climbing tools: skates

Hot sticks: wire tongs, wire tong supports, strain carrier, platform, saddle, lever lift, gin pole

ELECTRICAL LINE CONSTRUCTION WORKER
(Powerline Construction)

IMPORTANCE RANKINGS OF KNOWLEDGES

Knowledges are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The knowledges are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Knowledge of how to work with energized circuits
Knowledge of how to perform an emergency rescue
Knowledge of first aid
Knowledge of connections to be made for various transformers
Knowledge of what makes a wooden pole unsafe to climb
Knowledge of delta and wye transformer connections
Knowledge of specific job safety rules
Knowledge of appropriate hand signals to use with ground crew or equipment operators
Knowledge of which knot to tie in different circumstances
Knowledge of blueprints, including symbols used
Knowledge of the lifting capacity of various riggings for block and tackles
Knowledge of switching procedures
Knowledge of OSHA requirements
Knowledge of how to care for tools and equipment
Knowledge of strains and loads on a pole or tower that could require a guy wire
Knowledge of transformer ratings
Knowledge of how to erect a pulley system for lifting heavy objects
Knowledge of which materials are good conductors and insulators
Knowledge of the principles of grounding
Knowledge of hazardous materials
Knowledge of proper overcurrent protection for transformers
Knowledge of proper depth and width needed when digging holes for supporting poles
Knowledge of how many and which kinds of insulators to use on power lines
Knowledge of which ties to use with which types of insulators
Knowledge of inductance
Knowledge of parallel circuits
Knowledge of schematic electrical diagrams
Knowledge of direct and alternating current
Knowledge of which wire/cable to use in different circumstances
Knowledge of series circuits
Knowledge of fuse ratings
Knowledge of the functions of capacitors
Knowledge of combination circuits
Knowledge of the properties of high voltage cable
Knowledge of how a surge protector or lightning protector works
Knowledge of how a voltage regulator works
Knowledge of different types of guy anchors
Knowledge of Ohm's Law and related formulas

VERY TO MODERATELY IMPORTANT

Knowledge of how fuses operate
Knowledge of different types of pole and crossarm designs
Knowledge of how a circuit breaker works
Knowledge of the ratings of different types of switch gear
Knowledge of how transformers are constructed
Knowledge of resistance and its effects
Knowledge of circuit breaker ratings
Knowledge of the properties of different kinds of wooden poles
Knowledge of National Electrical Code
Knowledge of state and local electrical codes
Knowledge of the properties and use of insulating oils in transformers
Knowledge of power factor correction
Knowledge of the properties of metal, concrete or fiberglass poles and towers
Knowledge of how generators/alternators work
Knowledge of how to calculate degrees when bending conduit
Knowledge of sine waves generated by electrical power
Knowledge of how AC motors operate
Knowledge of different conduit bends (saddle, offset, etc.)
Knowledge of other crafts' cope of work and responsibilities
Knowledge of building specifications
Knowledge of the properties of fiber optic cable
Knowledge of the functions of batteries in providing electrical power
Knowledge of the effect of soil conditions on underground cable
Knowledge of photo-electric sensors

MODERATELY TO SOMEWHAT IMPORTANT

Knowledge of the properties of twisted pair cable
Knowledge of how DC motors operate
Knowledge of harmonic distortion of voltage/current
Knowledge of algebra
Knowledge of local area networks
Knowledge of the spacing of ducts needed in a duct bank
Knowledge of the properties of coaxial cable
Knowledge of ladder logic diagrams
Knowledge of geometry
Knowledge of process controllers and control loops
Knowledge of magnetic motor controls
Knowledge of temperature sensors
Knowledge of pressure-sensitive sensors
Knowledge of chemical sensors
Knowledge of level sensors
Knowledge of semiconductor electronics
Knowledge of solid state motor controls
Knowledge of trigonometry
Knowledge of programmable logic controllers
Knowledge of fire alarm systems
Knowledge of security systems
Knowledge of telephone and data systems
Knowledge of orthographic and isometric sketching
Knowledge of tree growth and pruning techniques
Knowledge of air conditioning and environmental control systems

ELECTRICAL LINE CONSTRUCTION WORKER
(Powerline Construction)

IMPORTANCE RANKINGS OF SKILLS

Skills are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The skills are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Skill at working in rubber gloves on high voltage lines
Skill at performing CPR
Skill at rigging equipment
Skill at tying knots
Skill at operating a bucket truck
Skill at splicing high voltage cable
Skill at terminating high voltage cable
Skill at splicing aluminum or copper cable
Skill at terminating aluminum or copper cable
Skill at driving a truck
Skill at splicing rope
Skill at operating platform lift
Skill at coiling and storing rope
Skill at reading a wire table to determine conductor size required

VERY TO MODERATELY IMPORTANT

Skill at operating a crane
Skill at terminating fiber optic cable
Skill at splicing fiber optic cable
Skill at terminating twisted pair cable
Skill at splicing twisted pair cable
Skill at terminating coaxial cable
Skill at splicing coaxial cable
Skill at welding
Skill at soldering
Skill at shoveling or raking wet concrete

MODERATELY TO SOMEWHAT IMPORTANT

Skill at programming programmable logic controllers

ELECTRICAL LINE CONSTRUCTION WORKER
(Powerline Construction)

IMPORTANCE RANKINGS OF ABILITIES

Abilities are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The abilities are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Ability to remain calm in an emergency situation
Ability to work at heights
Ability to understand verbal instructions and warnings
Ability to be self-motivated, responsible, and dependable without close supervision
Ability to maintain balance and perform construction tasks while on a ladder
Ability to work smoothly with others as a team to complete a task
Ability to communicate orally with others
Ability to hear warning signals
Ability to maintain good relations with others in a work setting
Ability to climb ladders and poles from 26 to 100 feet
Ability to reach and stretch to position equipment and fixtures while maintaining balance
Ability to work with both hands
Ability to climb ladders and poles up to 25 feet
Ability to coordinate body movements when using tools or equipment
Ability to climb poles above 100 feet
Ability to develop alternative solutions to a problem and choose the best alternative
Ability to operate two-handed power equipment
Ability to work outdoors in extreme weather conditions, including heat, cold ...
Ability to lift objects up to 50 pounds
Ability to work in extreme hot and cold temperature conditions
Ability to supervise and monitor the work of others
Ability to bend to get over or under objects while working on top a pole or tower
Ability to traverse irregular surfaces while maintaining balance
Ability to use muscular strength to raise and lower heavy objects on a line or pulley
Ability to use hands to manipulate small wires and objects
Ability to plan and organize tasks to meet deadlines
Ability to perform physical tasks all day without becoming overly tired
Ability to carry objects up to 50 pounds for short distances
Ability to add, subtract, multiply and divide and use formulas
Ability to lift objects above 50 pounds
Ability to discriminate between colors
Ability to bend or twist the body into unusual positions while working
Ability to read complex technical documents
Ability to push or pull heavy objects into position
Ability to read and understand graphs, charts and diagrams
Ability to walk long distances, sometimes over irregular terrain
Ability to carry objects above 50 pounds for short distances
Ability to apply muscular force quickly to objects and equipment
Ability to communicate in writing with others
Ability to work in a noisy environment

VERY TO MODERATELY IMPORTANT

Ability to work in unnatural positions for long periods of time
Ability to picture the way a construction project will appear before it is finished
Ability to work at depths, such as in trenches, manholes or deep vertical shafts
Ability to resist torque of motor while maintaining balance
Ability to understand how an electrical or mechanical system works

MODERATELY TO SOMEWHAT IMPORTANT

(There are no abilities in this division.)

JOB DESCRIPTION FOR ELECTRICAL RESIDENTIAL CONSTRUCTION WORKER (ERCW)

The duties of an ERCW are listed below. Tasks are described as daily, *weekly, monthly or occasionally* based upon the responses of a majority of ERCW in the position. Tasks that were rated *highly important* have an asterisk.

I. PLANNING AND INITIATING PROJECT

Daily — When planning a new project, an ERCW must study blueprints and specifications.* Materials must be loaded, hauled and unloaded at the job site. The ERCW establishes work areas and assembles tools and equipment.

Weekly — An ERCW coordinates tool requirements with the contractor. The job schedule is coordinated with other crafts.* Materials, supplies and equipment must be ordered to complete the job.*

Monthly — At times, an ERCW establishes timetables and/or progress charts for completion of the work. It may be necessary to obtain clearances, such as for digging.

Occasionally — An ERCW may be required to set up a temporary construction trailer or other control center at the site.

II. ESTABLISHING TEMPORARY POWER DURING CONSTRUCTION

Monthly — The ERCW may need to establish a temporary power source and maintain and repair it as needed during construction.

Occasionally — An ERCW may determine temporary power requirements by consulting with other crafts. Temporary power needs may need to be coordinated with a local power company, temporary panel(s) set up, and lines for temporary power and lighting run throughout the project.

III. ESTABLISHING GROUNDING SYSTEM

Monthly — The locations of the grounding conductors and connections are laid out first, then ERCW drives ground rods into the ground to establish a grounding system.* He or she must ensure that the ground cable and installation adheres to code.* The service panel is wired to the ground rod.* The breaker panel may be wired to the water pipe.*

Occasionally — An ERCW studies blueprints to determine a plan for the grounding system.* Next, the ERCW digs trenches or coordinates trench excavation performed by others. The ERCW positions the ground stakes and cable in the foundation trench. The area is backfilled with dirt.

IV. INSTALLING UNDERGROUND SYSTEM (SLAB/FOUNDATION)

Weekly

An ERCW must calculate the necessary bends, saddles and offsets needed to install conduit. The ERCW must determine where to place the junction boxes,* measure precisely where the conduit should land,* and the conduit needed to complete the run. In preparing the conduit for use, the ERCW must cut it to fit,* file or ream the inside to make it smooth,* and bend it to specifications.* The ERCW plumbs and levels the conduit and places the junction boxes where planned, making holes if needed, and making sure the box is plumb and level.

Monthly

An ERCW may study blueprints to determine the power source location* and/or to determine the placement of raceway systems (rigid, PVC, EMT, ENT).* He or she may need to read the building specifications to determine unique features.*

An ERCW determines the number of wires/cables that can be put into each conduit.* Sometimes holes must be cut in wood to run the conduit. Hangars and support for conduit may be built and installed. Raceway supports may also be installed. Conduit may need to be threaded and the ERCW may lay the conduit in the trenches.

Occasionally

An ERCW may be required to cut holes in concrete to run conduit. If conduit is laid in trenches, the ERCW may layout the trenches, dig them, grade and level them.

V. ROUGH-IN

Daily

An ERCW must install junction boxes. Cable or wire can be run from the panel box to fixtures or from the junction box to fixtures. He or she also installs switch boxes,* fixture boxes,* and branch circuits.* The circuits must be connected in line with code specifications.* An ERCW makes electrical connections in fixtures and receptacles.*

Weekly

An ERCW studies blueprints to identify circuits* and reads building specifications to identify unique features.* It may be necessary to work around other systems, such as air conditioning, to find a path for the lighting and receptacle wiring.* The ERCW measures the wire needed for various runs.* Conduit needed for various runs may also be measured. He or she must drill holes in wall supports to run the wire. Homeruns can be installed from the panel box, including 110v, 220v, and low voltage circuits.* Conduit may be run from the panel box to fixtures. Conduit may be run from the junction box to the fixture. An ERCW may need to install feeder circuits and small appliance circuits.* An ERCW may install telephone cable and termination jacks. Recessed lighting pods may be installed.

Monthly

An ERCW may need to determine the type and size of the service entrance equipment to install.* The master panel box for the residence may be mounted* and the panel directory made.* An ERCW may also install television cable. After work is finished, a ERCW may complete "as built" drawings.

VI. RUN WIRE

Weekly An ERCW runs fish tape through small conduit to establish a path for the wire. Wire must be measured and cut to the length needed.* Wire may be pulled through a raceway system.

Monthly An ERCW pulls rope through the conduit first before pulling the wire or cable. The rope is then connected to the wire for pulling. If necessary, lubricant is put on the wire to facilitate pulling. The ERCW pulls the wire by hand. Sometimes a "mouse" is used to pull a rope through the conduit. The cable must be anchored.

Occasionally An ERCW may need to use a machine tugger to pull certain types of cable.

VII. TRIM OUT

Weekly After the residential construction is largely complete, an ERCW installs lighting fixtures and secures fixture ornaments and covers.* Switches, receptacles and intercoms can be connected, and the plates and covers can be put on the receptacles.*

Monthly An ERCW may need to mount track lighting, install telephone receptacles, install and connect appliances, connect HVAC equipment, hang ceiling fans, and install television devices.

Occasionally Intercom devices may also need to be installed.

VIII. PERFORM HOT CHECKS

Weekly After wiring is complete, the ERCW checks the current and the voltage* and performs continuity checks of outlets.*

Monthly An ERCW performs continuity checks of fixtures and telephones. He or she checks and repairs any faults.* The master panel may be connected to a temporary source for power.

Occasionally A generator may be connected to the master panel for power. An ERCW may need to perform continuity checks on television cable.

IX. TROUBLESHOOTING AND REPAIRING ELECTRICAL SYSTEMS

Weekly An ERCW determines which lighting fixture or piece of equipment is not working properly.* Possible reasons for failure can be reviewed.* The problem can be analyzed through testing.*

Monthly An ERCW may discuss the problem with an operator or other witnesses.* The faulty unit or component can be localized and replaced or repaired as necessary.* The faulty section of a circuit may be identified using the split-half method.

X. SUPERVISING ERCW AND APPRENTICES

Weekly An ERCW assigns tasks to personnel, including apprentices.* The ERCW may need to teach a trainee a new task by explaining or demonstrating.* A ERCW is required to supervise worker performance and provide feedback to other ERCW and trainees.*

Monthly At least once a week, tasks must be reviewed to determine personnel scheduling.*

The following duties are an important part of the work of an ERCW, but are not performed as frequently as those duties already described.

XI. INSTALL SERVICE EXTENSION [UTILITY COMPANY]

Monthly The conduit is secured, wire or cable pulled, and necessary terminations made.

Occasionally An ERCW studies blueprints to determine where power will feed in.* The local power company may need to be contacted to determine the location of feeders.* The location of other electrical conduit or other structures, such as water mains, must be determined before locating the new feeders.*

When the locations of the feeders are determined, the ERCW lays out trenches for the conduit. The ERCW digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The ERCW installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be reinforced and the inside swabbed, if needed. The location of the conduit stubups may be measured and determined.* The ERCW then backfills the trench with dirt or other materials. Concrete may be poured over conduit in the trench.

XII. ESTABLISHING OSHA AND CUSTOMER SAFETY REQUIREMENTS

Daily On a daily basis, an ERCW must use proper tools and equipment in order to perform work safely.*

Weekly An ERCW must inspect and maintain personal protective equipment.* An ERCW sometimes uses protective devices when working with live conductors.* Job site safety meetings must be held.

Monthly An ERCW must review applicable OSHA safety standards in order to develop an on-site safety program. Customer safety requirements must be reviewed and incorporated in a safety plan and material safety data sheets must be checked.

Occasionally An ERCW may need to keep the public away from the working area.* A traffic control plan may need to be set up and maintained. At times, an ERCW is required to perform an emergency rescue and/or administer first aid* or CPR* to an injured victim.

The following duties are also an important part of the work of an ECW, but are performed only occasionally. The activities listed under each duty are generally performed each time the duty is required.

XIII. INSTALLING SWIMMING POOL EQUIPMENT

When installing a swimming pool, an ERCW digs a trench from the power source to the filter system. Conduit is placed in the trench and backfilled with dirt. The ERCW measures and locates conduit stubups and pulls wire to establish power. The filter system and time clock are connected. The system is tested to be sure that all elements are working.*

XIV. INSTALLING, MAINTAINING, AND REPAIRING SECURITY SYSTEMS

An ERCW studies blueprints to determine the locations of security system components* and reads the manual on the specific security system being installed.* A control panel for the system must be located and installed. The initiating and detection devices must be positioned and a connection made between these devices and the controller. The ERCW establishes raceways and control panels for the alarm system. Video equipment, including cameras and other monitors, may be positioned. Doors and windows may be wired to detect opening and closing. Motion detectors may also be placed and connected. An ERCW tests and adjusts the system.* He or she also programs and tests the security codes for the system.* The access codes are then distributed to the appropriate persons. Personnel may need to be trained on the use of the system.*

XV. INSTALLATION OF HOME AUTOMATION/ENERGY MANAGEMENT SYSTEMS

When installing a residential control system, an ERCW studies the blueprints and schematic diagrams for the system* and reads the manual on the system.* The layout for various devices must be determined, including various types of sensors.* The ERCW locates the instrumentation devices and builds raceways to hold the cables. Control panels must be installed, as well as conductors and tubing. The ERCW makes the electrical or pneumatic connections between the sensors and the controller. A central processing unit may need to be established. The ERCW programs the computer or other programmable control devices.* The instruments must be tested and calibrated. The ERCW performs a loop check and prepares loop sheets documenting the system as installed.

USE OF TOOLS

ERCW use a broad array of tools. Using the same procedures as above, we classified tools by frequency in the same manner. One tool -- the fiber optic fusion splicer -- was eliminated because it was used by less than 10 percent of the residential wiremen.

Daily

Hand tools: level, pliers, needle nose pliers, slip joint pliers, hammer, wire cutters, screw driver, measuring tape, ruler, hacksaw, wire stripper, ladder, knife

Power-assisted tools: hand drill, electric screw gun

Meters: voltmeter

Weekly

Hand tools: file, punch, fish tape, socket set, wrench, allen wrench, handsaw, keyhole saw, crimping tools, hand drill, hand bender, hand reamer, knock out sets, awl

Power-assisted tools: electric saber saw, electric roto hammer drill

Meters: ammeter

Monthly

Hand tools: plumb bob, fuse pullers, clamps, pipe wrench, wood chisel, shovel, tap and dies, architect scale

Power-assisted tools: roto stripper

Occasionally

Hand tools: torque wrench, transit, block and tackle, adapter cables, vise, caliper, tamp tool, hoist cum-a-long

Power-assisted tools: soldering iron, drill press, gas-operated auger, air hammer, coring machine (to drill through concrete), hydraulic bender, power cutting and threading machine, wire tugger, water pump

Meters: oscilloscope, wattmeter, optical power meter, MEGGER, dielectric test set to hipot cable, dynamometer, optical time-domain reflectometers

Heavy equipment: trencher, electric lift, bucket truck, crane, power borer, derrick, auger, dozer, backhoe, caterpillar

ELECTRICAL RESIDENTIAL CONSTRUCTION WORKER

IMPORTANCE RANKINGS OF KNOWLEDGES

Knowledges are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The knowledges are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Knowledge of National Electrical Code
Knowledge of state and local electrical codes
Knowledge of blueprints, including symbols used
Knowledge of how to work with energized circuits
Knowledge of the principles of grounding
Knowledge of which wire/cable to use in different circumstances
Knowledge of specific job safety rules
Knowledge of schematic electrical diagrams
Knowledge of first aid
Knowledge of OSHA requirements
Knowledge of hazardous materials
Knowledge of which materials are good conductors and insulators
Knowledge of circuit breaker ratings
Knowledge of fuse ratings
Knowledge of Ohm's Law and related formulas
Knowledge of direct and alternating current
Knowledge of parallel circuits
Knowledge of building specifications
Knowledge of how to care for tools and equipment
Knowledge of different conduit bends (saddle, offset, etc.)
Knowledge of how to perform an emergency rescue
Knowledge of how fuses operate
Knowledge of combination circuits
Knowledge of series circuits
Knowledge of how a circuit breaker works
Knowledge of the properties of high-voltage cable

VERY TO MODERATELY IMPORTANT

Knowledge of how to calculate degrees when bending conduit
Knowledge of resistance and its effects
Knowledge of proper overcurrent protection for transformers
Knowledge of switching procedures
Knowledge of transformer ratings
Knowledge of how a surge protector or lightning protector works
Knowledge of inductance
Knowledge of connections to be made for various transformers
Knowledge of the ratings of different types of switch gear
Knowledge of delta and wye transformer connections
Knowledge of how AC motors operate
Knowledge of ladder logic diagrams
Knowledge of magnetic motor controls

Knowledge of the effect of soil conditions on underground cable
Knowledge of power factor correction
Knowledge of fire alarm systems
Knowledge of how generators/alternators work
Knowledge of solid state motor controls
Knowledge of the functions of capacitors
Knowledge of the spacing of ducts needed in a duct bank
Knowledge of photo-electric sensors
Knowledge of algebra
Knowledge of how DC motors operate
Knowledge of the functions of batteries in providing electrical power
Knowledge of how a voltage regulator works
Knowledge of sine waves generated by electrical power
Knowledge of how transformers are constructed
Knowledge of other crafts' scope of work and responsibilities
Knowledge of temperature sensors
Knowledge of harmonic distortion of voltage/current
Knowledge of air conditioning and environmental control systems
Knowledge of geometry
Knowledge of pressure-sensitive sensors
Knowledge of proper depth and width needed when digging holes for supporting poles
Knowledge of security systems
Knowledge of the properties of twisted pair cable
Knowledge of properties of coaxial cable
Knowledge of appropriate hand signals to use with ground crew or equipment operators
Knowledge of programmable logic controllers
Knowledge of telephone and data systems
Knowledge of level sensors
Knowledge of the properties and use of insulating oils in transformers
Knowledge of which knot to tie in different circumstances
Knowledge of how to erect a pulley system for lifting heavy objects
Knowledge of process controllers and control loops
Knowledge of properties of fiber optic cable
Knowledge of the lifting capacity of various riggings for block and tackles
Knowledge of chemical sensors
Knowledge of trigonometry
Knowledge of what makes a wooden pole unsafe to climb

MODERATELY TO SOMEWHAT IMPORTANT

Knowledge of semiconductor electronics
Knowledge of the properties of metal, concrete or fiberglass poles and towers
Knowledge of strains and loads on a pole or tower that could require a guy wire
Knowledge of local area networks
Knowledge of how many and which kinds of insulators to use on power lines
Knowledge of which ties to use with which types of insulators
Knowledge of the properties of different kinds of wooden poles
Knowledge of different types of pole and crossarm designs
Knowledge of different types of guy anchors
Knowledge of orthographic and isometric sketching
Knowledge of tree growth and pruning techniques

ELECTRICAL RESIDENTIAL CONSTRUCTION WORKER

IMPORTANCE RANKING OF SKILLS

Skills are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The skills are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Skill at performing CPR
Skill at reading a wire table to determine conductor size required
Skill at terminating aluminum or copper cable

VERY TO MODERATELY IMPORTANT

Skill at splicing aluminum or copper cable
Skill at working in rubber gloves on high voltage lines
Skill at terminating high voltage cable
Skill at splicing high voltage cable
Skill at terminating twisted pair cable
Skill at splicing twisted pair cable
Skill at terminating coaxial cable
Skill at driving a truck
Skill at operating platform lift
Skill at typing knots
Skill at terminating fiber optic cable
Skill at rigging equipment
Skill at splicing fiber optic cable*
Skill at programming programmable logic controllers

MODERATELY TO SOMEWHAT IMPORTANT

Skill at soldering
Skill at operating a bucket truck
Skill at splicing rope
Skill at coiling and storing rope
Skill at welding
Skill at shoveling or raking wet concrete
Skill at operating a crane

ELECTRICAL RESIDENTIAL CONSTRUCTION WORKER

IMPORTANCE RANKING OF ABILITIES

Abilities are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The abilities are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

EXTREMELY TO VERY IMPORTANT

Ability to be self-motivated, responsible, and dependable without close supervision
Ability to work smoothly with others as a team to complete a task
Ability to understand verbal instructions and warnings
Ability to communicate orally with others
Ability to add, subtract, multiply and divide and use formulas
Ability to maintain good relations with others in a work setting
Ability to remain calm in an emergency situation
Ability to maintain balance and perform construction tasks while on a ladder, platform, pole or tower
Ability to plan and organize tasks to meet deadlines
Ability to work with both hands
Ability to develop alternative solutions to a problem and choose the best alternative
Ability to discriminate between colors
Ability to read complex technical documents, including manual on electrical equipment, code documents and safety rules
Ability to supervise and monitor the work of others
Ability to hear warning signals
Ability to read and understand graphs, charts and diagrams
Ability to communicate in writing with others
Ability to operate two-handed power equipment
Ability to use hands to manipulate small wires and objects

VERY TO MODERATELY IMPORTANT

Ability to reach and stretch to position equipment and fixtures while maintaining balance
Ability to lift objects up to 50 pounds
Ability to understand how an electrical or mechanical system works (such as security system or fire alarm system)
Ability to traverse irregular surfaces while maintaining balance
Ability to coordinate body movements when using tools or equipment
Ability to work at heights
Ability to climb ladders and poles up to 25 feet
Ability to work outdoors in extreme weather conditions, including heat, cold and precipitation
Ability to carry objects up to 50 pounds for short distances
Ability to work at depths, such as in trenches, manholes or deep vertical shafts
Ability to work in extreme hot and cold temperature conditions
Ability to picture the way a construction project will appear before it is finished
Ability to work in a noisy environment
Ability to perform physical tasks all day without becoming overly tired
Ability to apply muscular force quickly to objects and equipment (such as starting a hand saw)
Ability to lift objects above 50 pounds
Ability to push or pull heavy objects into position
Ability to carry objects above 50 pounds for short distances

Ability to bend or twist the body into unusual positions while working
Ability to use muscular strength to raise and lower heavy objects on a line or pulley
Ability to resist torque of motor while maintaining balance
Ability to walk long distances, sometimes over irregular terrain

MODERATELY TO SOMEWHAT IMPORTANT

Ability to work in unnatural positions for long periods of time
Ability to climb ladders and poles from 26 to 100 feet
Ability to bend to get over or under objects while working on top a pole or tower
Ability to climb poles above 100 feet

Appendix D:

ACT *Work Keys* Test Descriptions

Locating Information

Locating Information is a criterion-referenced assessment which measures the examinee's skill in using information taken from workplace graphic documents such as diagrams, blueprints, floor plans, tables, forms, graphs, charts, and instrument gauges. Examinees are asked to locate, insert, compare, and summarize information contained in one or more related graphics. At the highest level, examinees are asked to make decisions and draw conclusions based on information contained in one or more graphics.

Locating Information scores are reported on a scale from 3 to 6; Level 3 is the least complex and Level 6 is the most complex. Level 3 is established at about the point where a business would begin to show interest in assessing individuals. The highest level is set at the point where greater skill would require specialized training.

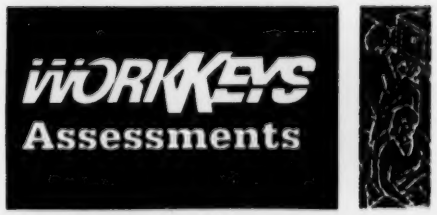
The scores from the Locating Information assessment indicate to the employer what examinees can understand or do at each skill level. By examining job requirements and their employees' scores, employers can determine if a training program is indicated and, if so, where to begin that program. Employers can reassess employees after training to evaluate the effectiveness of training activities in terms of whether those employees now meet the requirements of the job. Further, employers can use the scores achieved by potential employees or by employees being considered for promotion to help determine the best candidates for their jobs. Examinees who have taken the Locating Information assessment are provided documentation of their individual skill levels that can be attached to school admission or job applications. They also receive suggestions for improving their skills.

The assessment contains 32 multiple-choice questions that increase in difficulty. Testing time is 35 minutes. Completion of general information (e.g., name) requires about 15 to 20 additional minutes and optional items can further extend this time.

The score scale is constructed so that the examinee's level score represents correct responses to at least 6 of the 8 questions presented at that and all lower levels. Therefore, an examinee who achieves a score of Level 4 will have responded correctly to at least 6 of the 8 questions at Levels 3 and 4, and to fewer than 6 questions at Level 5.

Reading for Information

Reading for Information is a criterion-referenced assessment which measures the examinee's skill in reading and understanding work-related reading materials. Reading selections and questions based on the actual demands of the workplace appear in the form of memos, bulletins, notices, letters, policy manuals, and governmental regulations. Examinees are asked to identify the main points and significant details in these documents and to understand the steps in procedures, the meaning of policies and regulations, and the relevance of the information presented to new situations. At the highest levels, examinees are asked to make decisions and draw conclusions based on the reading materials.



Reading for Information scores are reported on a scale from 3 to 7; Level 3 is the least complex and Level 7 is the most complex. Level 3 is established at about the point where a business would begin to show interest in assessing individuals. The highest level is set at the point where greater skill would require specialized training.

The scores from the Reading for Information assessment indicate to the employer what examinees can understand or do at each skill level. By examining job requirements and their employee's scores, employers can determine if a training program is indicated and, if so, where to begin that program. Employers can reassess employees after training to evaluate the effectiveness of training activities in terms of whether those employees now meet the requirements of the job. Further, employers can use the scores achieved by potential employees or by employees being considered for promotion to help determine the best candidates for their jobs. Examinees who have taken the Reading for Information assessment are provided documentation of their individual skill levels that can be attached to school admission or job applications. They also receive suggestions for improving their skills.

The assessment contains 30 multiple-choice questions that increase in difficulty. Testing time is 40 minutes. Completion of general information (e.g., name) requires about 15 to 20 additional minutes and optional items can further extend this time.

The score scale is constructed so that the examinee's level score represents correct responses to at least 5 of the 6 questions presented at that and all lower levels. Therefore, an examinee who achieves a score of Level 5 will have responded correctly to at least 5 of the 6 questions at Levels 3, 4, and 5, and to fewer than 5 questions at Level 6.

Applied Technology

Applied Technology is a criterion-referenced assessment that measures an examinee's skill in solving problems of a technological nature. The content covers the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. Because this assessment is oriented toward reasoning rather than mathematics, any calculations required to solve a problem can be readily performed by hand. The emphasis is on identifying relevant aspects of problems, analyzing and ordering those aspects, and applying existing materials or methods to new situations.

Applied Technology scores are reported on a scale from 3 to 6; Level 3 is the least complex and Level 6 is the most complex. Level 3 is established at about the point where a business would begin to show interest in assessing individuals. The highest level is set at the point where greater skill would require specialized training.

The scores from the Applied Technology assessment indicate to the employer what examinees can understand or do at each skill level. By examining job requirements and their employees' scores, employers can determine if a training program is indicated and, if so, where to begin that program. Employers can reassess employees after training to evaluate the effectiveness of training activities in terms of whether those employees now meet the requirements of the job. Further, employers can use the scores achieved by potential employees or by employees being considered for promotion to help determine the best candidates for their jobs. Examinees who have taken the Applied Technology assessment are provided documentation of their individual skill levels that can be attached to school admission or job applications. They also receive suggestions for improving their skills.

The assessment contains 32 multiple-choice questions that increase in difficulty. Testing time is 45 minutes. Completion of general information (e.g., name) requires about 15 to 20 additional minutes and optional items can further extend this time.

The score scale is constructed so that the examinee's level score represents correct responses to at least 6 of the 8 questions presented at that and all lower levels. Therefore, an examinee who achieves a score of Level 4 will have responded correctly to at least 6 of the 8 questions at Levels 3 and 4, and to fewer than 6 questions at Level 5.

Applied Mathematics

Applied Mathematics is a criterion-referenced assessment which measures an examinee's skill in setting up and solving math problems using mathematical reasoning skills generally required in the workplace. The assessment questions require the examinee to set up and solve word problems similar to those found in the workplace. Examinees use a calculator when taking the test because calculators are used on the job. Examinees are also given a reference page that includes all the formulas needed to complete the assessment.

Applied Mathematics scores are reported on a scale from 3 to 7; Level 3 is the least complex and Level 7 is the most complex. Level 3 is established at about the point where a business would begin to show interest in assessing individuals. The highest level is set at the point where greater skill would require specialized training.

The scores from the Applied Mathematics assessment indicate to the employer what examinees can understand or do at each skill level. By examining job requirements and their employees' scores, employers can determine if a training program is indicated and, if so, where to begin that program. Employers can reassess employees after training to evaluate the effectiveness of training activities in terms of whether those employees now meet the requirements of the job. Further, employers can use the scores achieved by potential employees or by employees being considered for promotion to help determine the best candidates for their jobs. Examinees who have taken the Applied Mathematics assessment are provided documentation of their individual skill levels that can be attached to school admission or job applications. They also receive suggestions for improving their skills.

The assessment contains 30 multiple-choice questions that increase in difficulty. Testing time is 40 minutes. Completion of general information (e.g., name) requires about 15 to 20 additional minutes and optional items can further extend this time.

The score scale is constructed so that the examinee's level score represents correct responses to at least 5 of the 6 questions presented at that and all lower levels. Therefore, an examinee who achieves a score of Level 5 will have responded correctly to at least 5 of the 6 questions at Levels 3, 4, and 5, and to fewer than 5 questions at Level 6.

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